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Is there a Link between BMI and Adolescents' Educational Choices and Expectations?

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Abstract

One of the most claimed links in the health and education literature is that education prevents from the risk of overweight, and the negative link between education and BMI is up to now out of questioning. More educated adults tend to have lower body mass index (BMI) and a lower risk of overweight and obesity. However, recent literature started questioning the mechanism behind this education gradient in BMI. A more recent and alternative explanation is that the BMI-education gradient hides a selection mechanism, which makes adolescents with higher BMI are less likely to plan for, attend, and complete higher levels of education. In this paper we test for the selection mechanism behind the link between education and BMI by estimating the impact of adolescents' BMI on medium-long-term educational expectations and short-term school choices, while controlling for the potential endogeneity of BMI. Our IV estimates indicate that individuals high higher BMI have lower academic aspirations and are less likely to attend high school after finishing compulsory education, which is a pre-condition of the intentions to go college. These results support the selection (reverse causality) mechanism.

Keywords: Students' expectations; BMI; overweight; school choices; university; educational achievement.

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1. Introduction

The worldwide prevalence of overweight and obesity in childhood and adolescence has increased notably over the past decades (NCD Risk Factor Collaboration, 2017). Spain is not an exception. In 2017, the prevalence of overweight and obesity among Spanish youth (aged 2 to 17 years) was 18.3% and 10.3%, respectively (INE, 2017), being among of the most common chronic disorders not only in this age group, but also in adulthood. The rise in obesity among children and adolescents is considered a major health concern and urgently calls for attention (WHO, 2017). Thus, a growing body of research focuses on understanding the adverse health and socioeconomic consequences of overweight and obesity. Previous research has shown that overweight and obesity may have harmful effects on children's and adolescents' physical (Swallen et al., 2005; Daniels, 2009) and mental health1 (Roberts et al., 2013), social interactions and well-being (obese children face numerous hardships like stigma, bulling, discrimination, marginalisation2) and quality of life (Schwimmer et al., 2003; Tsiros et al., 2009; Griffiths et al., 2010). Moreover, overweight and obesity during childhood and adolescence may increase future health risks. Children and adolescents with overweight and obesity are very likely to become overweight and obese adults (NCD Risk Factor Collaboration, 2017), with higher probabilities of developing non-communicable diseases like diabetes, cardiovascular diseases or some cancers at younger ages (Singh et al., 2008; Park et al., 2012). In addition to poor health outcomes, obesity in adulthood may have

[1] See Mühling et al. (2016) and Quek et al. (2017) for recent reviews on the associations between overweight and obesity and depression in childhood and adolescence.

[2] A review on weight stigma in adolescents and children can be found in Puhl and Latner (2007). Some recent studies on weight-based victimization, bulling and discrimination include Puhl and Luedicke, 2012; Bacchini et al., 2015; Puhl et al, 2016; Puhl et al, 2017; Waasdorp et al., 2018; Himmestein and Puhl, 2019).

serious adverse social and economic consequences3 and further increase the inequality gradient in BMI (Baum II and Ruhm, 2009; Bann et al., 2017; Newton et al., 2017).

Assessing the association between overweight and obesity in youth and education is of considerable interest as both can be targeted, and improved, through policy interventions. Existing evidence consistently reveals that better educated individuals have on average lower body mass index (BMI) and are less likely to become overweight or obese than those less educated.[4] However, the educational gradient in BMI and obesity is mainly observed in high-income countries, which is in contrast to the situation in less affluent societies (Cutler and Lleras-Muney, 2012).

The literature has identified three causal mechanisms underlying the negative correlation between overweigh status and education, each bearing very different policy implications. The oldest and dominant view is that education is hypothesised to protect against overweight and obesity (Webbink et al., 2010; Kemptner et al., 2011; Brunello et al, 2013; Kim, 2016; Böckerman et al., 2017). According to this hypothesis, educated individuals have a better understanding of the adverse effects of overweight and obesity and tend to engage more in health-related behaviours that help to maintain normal weight status. It has been shown that education is associated with frequent exercising, better diet, lower alcohol consumption, and regular health check-ups (Kenkel, 1991; Doomers et al., 1999; Nayga, 2000; Cutler and Glaesaer, 2005; Fletcher and Frisvold, 2009; Lleras-Muney and Cutler, 2010;

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[3] Obesity is claimed to adversely impact a range of labour market outcomes (Lundborg et al., 2007; Morris, 2006; Norton and Han, 2008; Lindeboom et al, 2010; Böckerman et al., 2016). In particular, it is negatively associated with wages and earnings (Cawley, 2004; Cawley et al., 2005; Brunello and D'Hombres, 2007), income and wealth (Zagorsky, 2005; García-Villar and Quintana-Domeque, 2009), productivity (Neovius et al, 2012; Andreyeva et al., 2014) and the employment probability (Morris, 2007; Atella et al., 2008; Rooth, 2009; Caliendo and Lee, 2013; Reichert, 2015; Chu and Qhinmaa, 2016; Caliendo and Gehrsitz, 2016).
[4] See Cohen et al. (2013) for a systematic review of this literature.

Eide and Showalter, 2011). In addition, more educated people are more future oriented (Becker and Mulligan, 1997; Arendt, 2005) and have better sense of control (Mirowsky and Ross, 1998), which may make them avoid health-endangering lifestyles that may compromise important socioeconomic outcomes later in life (Sutter et al, 2013; Golsteyn et al., 2013). In addition, well-educated individuals live and work in environments that reduce the risk of weight gain and obesity (Burdette and Hill, 2008; Bell et al., 2014; Brown et al., 2014; Monsivais et al., 2015).

More recently, the hypothesis that the inverse relationship between education and overweight and obesity might also be due to reverse causality is gaining more interest among researchers. That is, students with unhealthy weight may also be less efficient in acquiring additional human capital. Grossman (2004) hypothesises about the reverse causality, while Von Hippel and Lynch (2014), Benson et al. (2017) and Hagman et al. (2017) provide empirical evidence that individuals with unhealthy weight attain lower levels of education. In this line of research, there is also growing literature that shows that overweight and obesity are also shown to result in poor academic performance and cognitive development (Sturn, 2006; Cawley and Spiess, 2008; Ding *et al.*, 2009; Averett & Stifel, 2010; Kark *et al.*, 2011; Han, 2012; Booth *el al.*, 2014; Black et al., 2015; Nghiem et al., 2018), more missed school days, frequent grade repetition and drop outs (Falkner *et al.*, 2001; Carey *et al.*, 2015) and worse teacher assessment (MacCann and Roberts, 2013; Zavodny, 2013). However, empirical literature regarding this issue is not unequivocal. A more reduced number of studies have found that higher weight has no effect on educational attainment or is even associated with better academic performance[5] (Pesa et al., 2000; Kim et al., 2003; Datar and Sturm, 2006; Wand and Veugelers, 2008; Kaestner and Grossman, 2009; Kaestner et al., 2011).

Finally, the third hypothesis states that the negative association may be driven by some unobserved factors that affect both education and overweight and obesity, such as the rate of time preference, attitudes towards risk, family background or psychological traits (Cutler and Lleras-Muney, 2006; Courtemanche et al., 2014; Stoklosa et al., 2018; Apouey and Geoffard, 2016; Madden, 2017). However, literature analysing this issue is less abundant, since available data to test for this hypothesis is rarely available.

The economic literature has endeavoured to disentangle the causal association between education and overweight and obesity, based on a comprehension of the three mechanisms explained above, but empirical evidence provides mixed results with regard to the extent and the direction of the effect. Different measures of educational achievement, econometric methods, narrow samples (e.g., with respect to gender or age), and data (cross-sectional vs. longitudinal) used across the different studies may be behind the inconclusive findings. For instance, the dominant view stating that education prevents from overweight is also motivated in part by the fact that most of the previous studies are based on cross-section data on adult population (e.g., Brunello et al., 2013; Amin et al., 2018). This type of data does not allow to test whether less educated adult population has a higher prevalence of overweight and obesity because having less education leaves them unprotected from overweight or because these individuals were already overweight or obese when they had

[5] This might be that that overweight and obese children, who usually spend less time playing sports and participating in social activities than their normal-weight counterparts, dedicate more time to studying and, as a consequence, obtain better results (Kaestner et al., 2011).

to decide whether to pursue or not higher levels of education. In part, the more recently embraced reverse causality hypothesis has gained popularity with the increasing availability of panel data that contains measures of adiposity, fat mass or body mass index (von Hinke Kessler Scholder et al., 2012; Chung et al., 2011; von Hippel and Lynch, 2014; Bell et al., 2014; Cheng et al., 2017; Benson et al., 2018), what allows to link live events, such as educational choices, with overweight measures.

Our analysis tries to deepen the understanding of the causal effect of overweight and obesity on education, by providing new evidence in a context that have not been so explored in the literature so far. This paper builds on the recent evidence suggesting that there is a strong association between BMI and educational outcomes. Therein, we focus on the reverse causality mechanism that averts higher-BMI adolescents to pursue lower levels of education. Our analysis is based on an ad-hoc survey carried out to more than 9000 secondary education students in Spain, where they were asked about their immediate school choices, educational aspirations, and medium-long-term educational expectations. More specifically, our paper adds to the scarce evidence exploring the impact of unhealthy weight on educational expectations, which are closely related to long-term education achievement such as attending and graduating from university, and greater aspiration to future employment and social status. To the best of our knowledge Ball et al (2004) and Clarke et al. (2013) are the only papers analysing the link between BMI and expectations of attending and graduating from higher education.

Analysing the effect of BMI on expectations or intentions rather than on the actual transition can be seen as a disadvantage. However, actual university enrolment is conditioned to specific educational choices regarding post-compulsory education. That is, in Spain the road to higher education has to follow a specific track. Therefore, examining short-term intentions after compulsory secondary education and choices regarding post-compulsory secondary education provide reliable information about the real intentions of and preferences for attending higher education of Spanish adolescents. Enrolment in the short run, and intentions and expectations in the medium run for secondary education students reveal adolescents' individual preferences for higher education. We aim to contribute to the unsettled debate on the causal interpretation of the relationship between education and overweight and obesity. Our analysis may provide some insights on the effectiveness of policy measures tackling obesity on reducing social disadvantages in education.

This paper makes several contributions to the literature. First, it aims to provide better understanding on the BMI gradient in education among adolescents. Second, our paper, which is the first of its kind for Spain, adds to the existing evidence on the causal links between education and overweight and obesity by studying a different institutional settings and cultural traditions to those previously examined in the literature. Previous literature analysing why and to what extent BMI predicts educational performance and achievement predominantly uses data from the USA (Crusnoe, 2007; Fowler-Brown et al., 2010; von Hippel and Lynch, 2014, Benson et al., 2018) with only few studies from other developed countries such as the UK (von Hinke Kessler Scholder et al., 2012), Germany (Cawley and Spiess, 2008) or Australia (Nghiem et al., 2018). Third, we use a unique database that contains a rich set of variables that allows to test for reverse causality while accounting for relevant confounding factors, which allow us to minimize the risk of individual unobserved heterogeneity bias. Our results confirm the reserve causality hypothesis, i.e., overweight students have lower expectations to achieve a university degree and are significantly less like to choose the post-compulsory secondary education track required to enrol in higher education.

The reminder of the paper is organised as follows. In the next section we review the existing empirical literature. Section 3 describes the institutional background in Spain. Data and the empirical strategy are presented in sections 4 and 5. In section 6 we report and discuss the empirical findings. The last section concludes.

2. Previous literature

In this section, we will focus on the literature analysing the impact of overweight on educational attainment. This is the literature in which our study can be framed. This literature comprises a growing number of studies that examines the causal effect of BMI or obesity on a wide range of educational outcomes.[6] At this regard, the empirical evidence regarding this link remains mixed. While the association between overweight and students' attainment in compulsory and post-compulsory non-tertiary education is weak,[7] evidence on the negative link between overweight and tertiary education outcomes is more conclusive.[8] Few studies find that obesity adversely impacts the likelihood of completing compulsory education or advancing to higher education in adolescence and young

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[6] In particular, higher body weight may lower the chances or aspirations of completing secondary or higher education, increase school-related problems, such as truancy, grade repetition, or low engagement, or, hamper academic performance.

[7] Martin et al. (2017) systematically overview the literature linking childhood obesity and academic achievement in non-tertiary education. They conclude that suggested that relationships between obesity and academic achievement are not well established, except for adolescent girls' math attainment, potentially mediated by both weight-related bullying and executive cognitive functions.

[8] Hill et al. (2019) offers an extensive overview about the relationship between obesity and tertiary education outcomes. They observe that all cross-sectional studies (6) and 8 of 10 longitudinal studies reported lower educational achievement in tertiary education in terms of enrolment and graduation.

adulthood. Using data from the National Longitudinal Survey of Youth 1979, Gortmaker et al. (1993) examined the relationship between adolescents' and young adults' (aged 16 to 24) weight status in 1881 and a range of social, economic and psychological outcomes, including years of schooling and graduating from college seven years later. The authors reported that overweight in youth was associated with completing fewer years of schooling for women and with lower likelihood of graduating from college for men.

Falkner et al. (2001) assessed the differences in overweight and non-overweight adolescents' educational experiences (liking school, academic performance, grade repetition) and expectations (finishing school, graduating from college) in public schools in the USA. Adolescents with above normal weight perceive themselves below average students, more likely to report being held back a year and to expect not to graduate from college than their normal weight counterparts. In addition, overweight and obese adolescent boys but not girls report more often they expect to quit school. Similarly, Carey et al. (2015) estimated the impact of US children and adolescents' weight status on school absences, having problems at school, grade repletion and low school engagement (student cares about doing well in school and doing required homework). Obesity was shown to adversely affect all educational outcomes but grade repletion, while overweight was only significantly associated with higher prevalence of school problems.

Our paper is also related to the growing literature on the impact of overweight and obesity on academic performance (see Taras and Potts-Datema, 2005; Caird et al, 2011; Santana et al, 2017, Martin, 2017 for reviews) and cognitive functioning (Miller et al, 2015). Most of these studies provide conflicting results and some modest evidence of poorer performance in maths among overweight girls compared to their normal weight counterparts. Averett and Stifel (2010) found evidence on the adverse consequences of childhood overweight on cognitive development in a sample of children aged 6 to 13. They used the mother's BMI recorded prior to her first pregnancy and its square to instrument for child's fat mass. White boys who were overweight were scoring less than their peers in both maths and reading. Overweight white girls had lower math scores, but significantly less important in magnitude than for white boys. Black boys and girls with overweigh performed worse only on reading tests. Ding et al. (2009) analysed how health conditions, weight status among them, affected academic performance during adolescence. To identify the causal effect of BMI on education, an instrumental variables strategy was adopted. The authors found a robust adverse impact of obesity on education. Moreover, health and weight disadvantages significantly reduced academic performance among girls, but not among boys. Using a similar approach to Ding et al. (2009), Fletcher and Lehrer (2011) studied genetic inheritance among children in the same household to estimate the link between poor health outcomes and academic performance. The authors estimated no significant association between obesity and academic achievement among American adolescents once genetic markers and family background were taken into account. Sabia (2007) also revealed a rather small impact of changes in weight status in 14-17 year-old adolescents on their academic performance and only for while female. Mother's and father's perceived obesity are used to instrument for the adolescent's weight status. Using data from the UK, von Hinke Kessler Scholder et al. (2012) examined the relationship between weight status and academic outcomes. Two models were estimated. The OLS regression that controlled for a wide set of covariates found a negative impact of fat mass on academic results at age 11. In contrast, genetic instrumental variables estimates showed no evidence of weight hampering academic performance.

Our paper is close to three recent studies that estimated the impact of adolescents' weight status on the likelihood of advancing to higher education, and having a bachelor's degree (von Hippel and Lynch, 2014; Hagman et al., 2017; Benson et al., 2018). These papers provided evidence in favour of the reverse causality hypothesis behind the association between BMI and education, while demonstrating only a small protective effect of completing higher levels of education on BMI growth. Von Hippel and Lynch (2014) employed data from the 1997 cohort of the National Longitudinal Survey of Youth (NYSY97) to determine whether higher-BMI adolescents were less likely to complete higher levels of education (at age 29) and whether having attained an advanced degree helps to restrain weight gain in early adulthood. They reported that adolescents who were overweight or obese had lower odds of completing higher education compared to their normal weight peers. The authors also found that being better educated only marginally reduced the BMI growth in early adulthood. Both effects were stronger for females than for males.

Similarly, Benson et al. (2018) argued that the association between BMI and education might differ in a cohort that grew before the obesity epidemic, i.e. the 1979 cohort of the National Longitudinal Survey of Youth (NYSY79), and that educational benefits might accumulate and be more pronounced in middle adulthood. Young women who were overweight or obese were less likely to advance to higher levels of education than their normal weight counterparts. The effect of BMI played turned out to be insignificant for young men. Moreover, the causal effect of education attainment on BMI was not large, accounting for less than 30% of the association. Hagman et al. (2017) also explored the impact of childhood obesity on competing 12 or more years of schooling in young adulthood in Sweden. The authors not only provided strong evidence for the reverse causality hypothesis, but also showed that the degree of obesity, moderate versus morbid, differently impacts the odds of completing compulsory schooling. In addition, a decrease in BMI or initiation of obesity treatment at a younger age were found to exert a positive influence on educational outcomes.

Two papers showing the lower expectations of further education among young people with obesity are also relevant to our study (Bell et al., 2004; Clarke et al., 2013). The work by Bell et al. (2004) revealed that obese women in Australia were less likely to aspire to higher education compared with their non-obese counterparts. In a certain way, this study tests the reverse causality hypothesis. Clarke at al. (2013), on the contrary, provided evidence of the protective effect of educational expectations on weight trajectories among high school seniors in the USA. They found that expectations to graduate from college led to a reduced weight gain over early adulthood, which is consistent with the idea that reduced expectations for the future may foster the adoption of unhealthier habits, such as no exercising or inappropriate diet, increasing the odds of obesity.

3. Institutional background: The road to higher education in Spain

In this paper, we study how BMI affects compulsory secondary education students' expectations to achieve a university degree. To assess whether this link is reliable, we also analyse the impact of BMI on the school choices that makes it possible to enrol in higher-education 2 years after, that is the post-compulsory secondary education pre-university track (high-school). At this regard, it is important to make clear which is the road from compulsory secondary to higher education.

Basic education in Spain is compulsory and free for all children aged between 6 and 16. Students complete six years of primary school followed by four years of compulsory secondary education (hereafter, *ESO*). An alternative pathway to complete compulsory secondary education is to attend the first three grades of *ESO* and attending one year of the lower vocational training track, which usually takes two years. This possibility is offered to give the last year's *ESO* dropouts the possibility of having a secondary compulsory education certificate. Upon completion of compulsory education, graduates can proceed to post-compulsory secondary education that can be differentiated into two tracks: vocational-professional track (hereafter, *CFGM)* and a pre-university track (hereafter, *high-school*). Only students completing high-school can sit for the university entrance exam than enables students to enrol in higher education. A legislative reform introduced in 2013 allows students holding upper vocational training diplomas to apply directly to higher education. Since then, around 15% of all newly enrolled students in Catalan universities follow this path.

With this institutional setting, it is important to remark that students who have intention, expectation or aspiration to attend higher education, enrol in high-school after completing compulsory secondary education, since it is the shortest track (two years) and also provides pre-university specific education. On the contrary, accessing to higher education through upper vocational programmes requires four years (2+2) and do not offer any type of specific education intended to prepare students to go to the university. The paths to higher education are shown in Figure 1.

[Figure 1, around here]

4. Data and variables

4.1. Data source

The data used in this study comes from a survey conducted in April/May 2016 in secondary education schools in Catalonia, a northeast region of Spain. The survey was especially designed to collect data for a research programme on the determinants of school success in secondary education. The database contains socio-demographic characteristics, personality traits, cognitive and non-cognitive skills, family background, school outcomes, students' academic intentions for the next year, and academic and labour market expectations in the medium and long-term. The surveyed students were attending the last year of compulsory secondary education (age 15-16) or enrolled in post-compulsory lower vocational training track or high-school (age 17-18).

The invitation to participate in the survey was sent out to all public secondary schools in Catalonia (614), from which 92 agreed to participate. This is a reasonably good sample, since it constitutes 15% of all public schools in Catalonia, which provides a sample of 9,550 students. Almost half of the students (45.5%) are attending the last grade of compulsory secondary education, 35.7% are enrolled in high-school, and the remaining 18.7% are attending the lower vocational track. In this study we will focus on those students attending the last grade of compulsory secondary education, since it is in this year when students have to make the school choices that puts them or not on the track to university. Factors affecting the decision to go to university are expected to have the highest incidence in that moment and not latter.

Although our sample is not random, it is very representative of the Catalan adolescent population. As we show in Table 1, we did not encounter significant differences between our data and comparable figures from official administrative sources or other surveys. As we will see bellow, the distribution of our key variables, namely, expectations to have a college degree, secondary post-compulsory education tracks chosen, and students' BMI do not differ from the distribution of students' expectation to have a university degree that can be found in the 2015 PISA report for Catalonia, the distribution of school choices reported by the Regional Government of Catalonia, and the adolescents' BMI observed in the Health Survey of Catalonia for the same year.

4.2. Outcome variables: Educational expectations and the pathway to university

We use a set of dependent variables to assess the relationship between BMI and educational choices and expectations. The first one is based on the responses to the following question: *"Which is the highest level of education you expect to achieve?"*. From the answers, we define a binary variable that takes the value 1 if surveyed students expect they will graduate from university in the future, and 0 for those who expect to achieve a lower level of education than university.

Second, at their last year of compulsory secondary school students have to report their educational choices for the following year. The timing of our survey is very convenient, since it was carried out at the end of the academic year. Therefore, most of the students already knew what they wanted to do the next year at the moment of the survey. Students could choose between attending high-school, lower vocational training track or no further education. Since those students who really have the intention to go to the university when they complete secondary education have to enrol in high-school, we create a dummy variable taking the value 1 if students report that the next year are going to attend high-school and 0 otherwise. Finally, to check the robustness of our findings with the variable regarding the intentions to go to high-school next year, we also included an alternative specification using the sample of students in post-compulsory secondary education. Our third dependent variable takes the value 1 for students attending high-school in the year the survey was conducted and 0 for their counterparts enrolled in a lower vocational training programme.

One interesting feature of our data is that they reproduce with accuracy the choices done by the population of students in Catalonia. In Table 1, we compare our outcome variables, that is, the educational expectations and the schooling intentions in our sample with the administrative data provided by the Regional Government of Catalonia. According to this source, approximately, 66% of the students who finish secondary-compulsory education, opt for attending high-school. This proportion is higher for girls (around 70%) than for boys (around 60%). Our data match these numbers. From the 92 schools that decided to participate in our study, we got that share of students attending high-school was of 65.6%, being these figures of 70.2% for girls and 60.2% for boys.

Regarding the intentions to go to high-school or to enrol in the vocational track after completing compulsory education, our data also reproduce the official data coming from the Regional Government of Catalonia. For the sample of students in the last year of compulsory education, almost 60% answered that they are going to attend high-school, while 33% answered that they were going to attend the lower vocational track. The proportion of girls that wanted to go to high-school was of 63%, while this figure was of 54% for boys. The small discrepancies with the administrative, around 5-6 percentage points, are due to the fraction of surveyed students that answer they do not know what are they going to do next year.

Our key outcome variable, that is, expectations to achieve a university degree, also behave as in other well-known surveys. More specifically, in our data the share of students who expect to complete a university degree is of 56.3%. Girls are more likely to report they expect to get a university degree (62.6%) than boys (49.6%). In the 2015 wave of PISA, this question was also made to all participants in the last grade of compulsory secondary education. The results indicated that 59.2% of the Catalan students expected to graduate from university. The figures were 63.5% for girls and 55.1% for boys, which are practically the same as the ones observed in our data.

Finally, also according to the Regional Government of Catalonia, approximately 75% of the Catalan students who successfully graduate from high-school choose to attend higher education[9], while the remaining 25% either opt for advanced vocational training programmes or enter the labour market. In our survey, the share of students in the last year of high-school that reported intentions to go to the university the next year was of 67%, while the share of the students that answered they were going to take an upper vocational programme was of 19%. The proportion of girls that wanted to go to the university was of 70%, while this figure was of 62% for boys. All this evidence taken together indicates that despite our sample is not random, it is quite representative of the population of secondary education students in Catalonia. Therefore, we may plausibly state that the schools' decision to participate or not in the survey was random.

[9] In order to be admitted to higher education it is compulsory to pass a national university entrance exam. This exam success rate is usually above 90%. The exam is structured in two parts: general (compulsory) and specific (voluntary). The average grade obtained in the general part accounts for 40% of the final grade and the average grade from high-school accounts for the remaining 60%. The voluntary part can add up to 4 additional points. The university entrance grade determines if students may apply for admission and is also used to rank them according to their stated preference Students are allowed to choose and rank up to eight different university majors.

[Table 1, around here]

4.3. Body Mass Index (BMI)

Adolescents' body mass index (BMI) is calculated as self-reported weight in kilograms divided by self-reported height in meters squared. Although height and weight are not objectively measured by trained personnel, the downward bias in self-reported BMI is shown to be relatively small among adolescents (Gorber et al, 2007; Sherry et al., 2007; Gokler et al., 2018). In our regressions, we use BMI in continuous format instead of its categorization indicating different weight categories. We believe that BMI scores depict better the differences in size and changes over time during adolescence. Average BMI was 21 for girls and 21.3 for boys (Table 2). Overweight rates were approximately 15% for both girls and boys. Although the prevalence of overweight in our sample was similar, there are differences by sex that are revealed by the kernel density estimates (Fig. 2). The distribution for boys/girls is slightly positively skewed.

We use the categorization of BMI by weight groups only for descriptive purposes. We define overweight based on International Obesity Task Force's cut-points for the participants up until age 18 (Cole and Lobstein, 2012) and by the adult World Health Organization cut-offs from age 18 (WHO, 2000). In Figure 3, we compare the distribution of our BMI measure, split by weight categories, with the one obtained from the Health Survey of Catalonia of 2015. It can be observed that both distributions match with a high degree of accuracy.

[Figure 2, around here]

[Figure 3, around here]

4.4. Covariates

We control for a wide set of covariates that are hypothesised to have an impact on the decision to pursue university education. Besides the usual socio-demographic characteristics, we include information on cognitive and non-cognitive abilities. Cognitive abilities are proxied by a variable indicating the time spent competing the survey[10] and a dummy for diagnosed learning handicap. The number of hours dedicated to homework per day is our indicator for non-cognitive skills. We also control for the students' birthplace (Catalonia, rest of Spain and abroad).

Given the existing evidence on the persistent gap in college enrolment by family background (e.g., Bailey and Dynarski, 2011), we control for paternal education (dummy variables that equal one for one or both parents holding a university degree and zero otherwise). Marital status of the parents (single, married or cohabiting, divorced or widowed) and the number of siblings. In addition, we also controlled for the number of siblings who had dropped out from school, this is quite interesting factor since it picks-up factors related with the family background, such as the influence of the siblings or also some potential inherited characteristics Finally, we constructed an indicator variable reflecting parents' involvement in children's education. It is based on two questions on parents' helping with homework and attending school meetings with teachers. Both parents assess

[10] We consider that the longer it takes to complete the survey, the lower students' cognitive abilities are. It may also pick-up other non-cognitive factors such as lack of motivation with the survey, which can be extensible to other aspects, or the study process.

their involvement with responses ranking frequency in a scale ranging from never (codes as 0) to always (coded as 4). We sum mother and father responses to each indicator, thus each of these parents' involvement indicators take values from 0 to 8.

Descriptive statistics are given in Table 2. Our main sample consists of 3,065 students in the last year of compulsory secondary education for whom we have complete answers regarding all our variables of interest, 51.7% of them are girls. The share of immigrants was 18% for girls and 15% for boys. Girls spend more time doing homework than boys, 2.1 and 1.4 hours per day, respectively. Around 8% of the girls and 10% of the boys declare they have been diagnosed with learning handicap. Mothers attend school meetings and help with studies more than fathers do. Most students live in households with both parents (around 70%), while one in four lives in a uniparental household (with either single, divorced or widowed parent). Regarding the education of the parents, 9% of the students have both parents with university degree, for 15% only the father is university graduate and for 21% the mother is the one holding a higher education diploma.

[Table 2, around here]

5. Empirical framework

5.1. Econometric model

To estimate the impact of BMI on students' expectations to complete university education, and the pre-university school choices we begin with the following linear probability model:

$$y_i = \alpha + \beta (BMI)_i + \delta X_i + \varepsilon_i \,, \qquad (1)$$

where y_i is a dummy variable that takes the value 1 for those students who expect to graduate from university, and 0 otherwise. Analogously, y_i also represents the probability of attending high-school or not after completing compulsory education. We assume that this variable is a function of the student's BMI and a set of individual and family background characteristics (X_i). The term ε_i is a random error term, which includes both individual/family and school unobserved heterogeneity affecting the outcome variable y_i. The parameter of interest β captures the relationship between BMI and the outcome y_i.

One concern regarding the estimation of the parameter of interest β is the potential correlation between BMI and the error term ε_i, i.e., the unobserved heterogeneity contained in ε_i affects simultaneously BMI and y_i. If $E(BMI, \varepsilon_i) \neq 0$, applying the OLS technique to equation (1) gives an inconsistent estimate of β. In this context, the estimate of β is likely to be biased downwards if the BMI is related negatively with students' expectations of obtaining university degree.

The existing literature analyzing the determinants of academic attainment tend to omit the existence of school unobserved heterogeneity. The reason for this is that, unlike our study, most previous studies rely on register or survey data that do not provide information on the school the surveyed individuals are enrolled. As a result, the parameter β may be affected by a problem of omitted variable bias in the best of the cases, and by a problem of endogeneity in the worst of the cases if this school unobserved heterogeneity is simultaneously correlated with BMI and educational achievement.[11] To avoid this harmful impact of unobserved school characteristics on the causal estimation of the relation between BMI and educational outcomes, we expand equation (1) as follows:

[11] Several studies find that school characteristics have an impact on educational achievement (e.g., Autor et al.,2016; Deming et al., 2014; Booker, et al., 2011). The influence of school peers on students' BMI is also well-documented (e.g., Asirvatham et al., 2018; Halliday and Kwak, 2009).

$$y_{ij} = \alpha + \beta(BMI)_{ij} + \delta X_{ij} + \lambda_j + u_{ij}, \qquad (2)$$

where the subscript j refers to the school where the individual i is studying and λ_j represent school fixed-effects. The parameter of interest β is then estimated by OLS using the following equation:

$$(y_{ij} - \overline{y_j}) = \alpha + \beta(BMI_{ij} - \overline{BMI_j}) + \delta(X_{ij} - \overline{X_j}) + (u_{ij} - \overline{u_j}), \qquad (3)$$

which can be expressed as follows:

$$y_i^* = \alpha + \beta BMI_i^* + \delta X_i^* + u_i^*, \qquad (4)$$

In equation (4), even after accounting for the unobserved school characteristics, there is a number of reasons of why BMI can still be endogenous. Contrary to what may happen in the relationship between BMI and school achievement, we do not think that simultaneous causation is a problem if the outcome variable is academic expectations; however, omitted variable bias can be still a problem, since there might be a number of unobservable variables, generally psychologic factors or personality traits, affecting both BMI and educational expectations. As we mentioned above, applying OLS estimation to equation (4) will yield biased estimates of the causal effect of BMI on educational expectations. In this context, instrumental variables (IV) estimation is the method that will provide reliable estimates of the causal relationship. Thus, the unbiased estimator of our parameter of interest β obtained using IV will be:

$$y_i^* = \alpha + \beta^{IV} BMI_i^* + \delta X_i^* + u_i^*, \qquad (5)$$

where in equation (5), BMI_i^* is the prediction of the BMI obtained through the following linear relationship:

$$BMI_i^* = \gamma Z_i^* + \eta X_i^* + \nu_i^*. \qquad (6)$$

In equation (6), the matrix Z_i^* contains a set of variables (instruments) that are correlated with BMI_i^*. Both u_i^* and ν_i^* are independent. In this setting, the IV estimation expressed in equation (5) uses the set of instruments Z included in equation (6) to isolate the exogenous variation in BMI_i^*, thus yielding an unbiased estimate of β^{IV}.

Finding suitable instruments (Z) which are truly exogenous is a challenge. These instruments must be partially correlated with the BMI but uncorrelated with the error term in the outcome equation. If these two conditions are not satisfied, the IV estimation of our parameter of interest β^{IV} in equation (5) will be biased.

5.2. Instruments

As explained above, although we control for unobserved heterogeneity across schools, there may still exist individual unobserved heterogeneity, which in turn might be a source of endogeneity since it can affect simultaneously both the students' BMI and their educational expectations and school choices. To the best of our knowledge, there is little previous evidence linking BMI to expectations; however, in the existing studies that analyze the association between BMI and observed cognitive achievement, endogeneity is a recurrent issue. Thus, the empirical approach we finally followed is the IV estimator.

The most commonly used instruments for BMI are genetic markers (Norton and Han, 2008; Ding et al., 2009; von Hinke Kessler Scholder et al., 2012), students' past weight status (Kaestner and Grossman, 2009) or the obesity status of biological relatives (e.g. Sabia, 2007; Averett and Stifel, 2010). Unfortunately, none of these instruments are available in our data. However, one interesting feature of our data is that we can identify not only the school students are currently attending, but also the class each student is assigned to. This allows us to build an instrument based on the BMI of the peers. In particular, we instrument individual's BMI using the average BMI of the same-sex classmates. We consider that this a good instrument, since Spanish students generally share classes with the same group of peers along all grades of compulsory education. Peers' overweight is found to have an impact on teenagers' overweight status (e.g. Trogdon et al., 2008; Mora and Gil, 2013), but there is no reason to think that the peers' BMI could have a direct impact on teenagers' academic expectations to graduate from university or school choices in the short term.

Our instrument can be considered a more accurate version of the so-called area-based instruments, commonly used in cross-sectional studies that lack other potential instruments as the ones mentioned at the beginning of this sub-section. Area-based instruments have proved to perform quite well in studies analyzing a wide variety of issues regarding returns to schooling (Card, 1995), child health (Currie and Cole, 1993), nursing homes spill-overs (Grabowski and Hirth, 2003), health insurance coverage (Lo Sasso and Buchmueller, 2004), hospital ownership (Sloan et al., 2001) or occupational attainment (Morris, 2006; Mora, 2010).[12]

[12] Our study is similar to Morris (2006) that instrumented individual BMI by the mean BMI across individuals living in the area in which the respondent lives.

Finding a good instrument is quite challenging. First, it should be correlated with BMI, which can be easily tested by including the instrument (Z) in equation (6), and testing for its statistical significance using a F-test. However, with only one instrument, equation (5) will be exactly identified and testing for the exogeneity of the instrument is not possible (Wooldridge, 2002). However, this test can be carried out in an overidentified model. Thus, a second instrument is needed to test for the exogeneity of the instruments. Our data contains information on the number of daily hours of sleep and whether students practice sports as an extra scholar activity. Several studies showed that both variables are correlated with the BMI (e.g., Krističević et al., 2018; Potter et al., 2017). Nonetheless, it is plausible to assume that sleeping and sportive habits are not correlated to students' expectations, as our data confirmed. Thus, the number of hours of sleep or the sportive habits can be used instrumentally to test for the exogeneity of our main instrument, i.e. average BMI of the same-sex classmates.

6. Econometric results: Determinants of the expectations to graduate from university and intentions to go high school

6.1. The impact of the control variables

Table 3 reports the results of OLS estimations of the determinants of the expectations to complete university, the intentions to attend high school in the following year, and the probability of being currently attending high-school (vs. lower vocational track). The estimates are done separately for girls and boys. In this subsection, we focus on the impact of all control variables except the BMI, which will be commented in more detail in the next subsection.

As expected, cognitive impairments significantly hamper students' expectations to have a university degree, and the probability of attending high-school after completing compulsory secondary education, for both boys and girls. Girls who spent more time completing the survey also have poorer academic expectations and are less likely to enrol in high-school. This variable has not turned out to be significant for boys. Non-cognitive abilities, such as study effort, are also important. Boys and girls who dedicate more hours to complete homework activities are more likely to report they expect to graduate from university, to attend high school next year, and being currently studying high-school. Being born in Catalonia, gives students an advantage in expecting to progress to higher education compared to their counterparts born in the rest of Spain or abroad. This might be partly explained by the unilingual (Catalan) system followed in Catalan schools.

Regarding family background, adolescents from families where one of the parents holds a university degree are more likely to aspire to higher educational attainment, and enrol in higher education. However, being born in a family where both parents are university graduates do not increase this probability respect of having only one parent with higher education. Marital status of the parents does not seem to have an unambiguous impact, and statistical significance vary across alternative models and samples. The same can be said regarding parents' involvement with children's' education. Our results suggest that a greater parents' involvement increases educational expectations for girls, but not for boys. Indeed, for boys, we observe a negative sign, which is statistically significant for the probability of attending high-school next year. Finally, girls with more siblings are more prone to report poorer academic expectations. However, this variable does not seem to be important for boys. Finally, having siblings who dropped out of school also have a negative impact on students' expectation to attend high school or to complete university, however, this effect is stronger for boys.

6.2. The impact of the BMI

Our main interest is the causal impact of BMI on the two educational expectations outcomes. Thus, besides the baseline OLS regression discussed above, we also estimate IV models. Tables 4 to 6 report results of the models that regress the three outcome variables on BMI using IV. In these models, we control for the same set of regressors than in the OLS models. The effects of these controls on the outcome variables do not vary with respect to the OLS estimates and, therefore, are not shown here. We also report the statistical tests for the exogeneity of the BMI, as well as for the validity of the instruments. The exogeneity of the BMI consists of estimating the following equation:

$$y_i^* = \alpha + \beta(BMI)_i^* + \delta X_i^* + \lambda \hat{\nu}_i^* + \varepsilon_i^*, \tag{7}$$

where $\hat{\nu}_i^*$ are the estimated residuals from equation (6), under the null hypothesis of the exogeneity of BMI, λ=0 (Hausman, 1978). The estimated values for λ are reported in column (2) in each table. Tests on the individual significance of λ reveal that BMI is always endogenous for girls. However, for boys, BMI turned out to be endogenous only in the model that estimates the probability of being currently attending high-school (vs. lower vocational track). Regarding our instrument, average BMI of the same-sex classmates, the statistical tests reveal that it is a good instrument in all models. Recall that we carry out two IV estimations: one with our main instrument (average BMI of the same-sex classmates), and a second with the main instrument and an auxiliary instrument (sleeping hours or practice sports). The second regression is carried out to test for the exogeneity of the main instrument, since with exact identification (only one instrument), exogeneity test of the instrument cannot be performed. The auxiliary instrument has been chosen in a way that do not change the estimated coefficient of the IV regression with only the main instrument. The statistical tests reveal that our instrument is good in all models. The under-identification test (column 3) indicates that the instrument is strongly correlated with BMI, while the weak identification test (column 4) indicates that the instrument is not weak. Finally, and more importantly, the Sargan-Hansen test (column 5) confirms the exogeneity of the instruments. All these tests indicate the validity of the instrument and ensure that the causal effect of BMI on students' educational expectations can be estimated consistently.

In table 4, we show the estimates of the impact of BMI on the expectations to complete university. In table 5, we present the results regarding the intentions to attend high school next year. Finally, in table 6, results regarding the probability of being currently studying high-school (vs. lower vocational track) are reported. Our results indicate that BMI has a significant negative impact on the probability of expecting to complete a university degree only for girls. More specifically, we estimate that five units of increase in BMI (the change between healthy weigh and overweight) reduces the girls' expectations to complete higher education by 13 percentage points. We also find that BMI is significantly associated with the intentions to attend high school next year and the probability of being currently enrolled in high-school (vs. lower vocational track) for both girls and boys. In both cases, results are remarkably more sizable for girls than for boys. We estimate that for girls, five units of increase in BMI (the change between healthy weigh and overweight) reduces the intention to attend high-school next year if 25 percentage points, and the probability of being currently enrolled in high-school in 28 percentage points. These figures are of 15 and 20 percentage points for boys, respectively.

7. Discussion and conclusions

Much of the evidence of the causal effects of overweight and obesity on education focuses on academic performance, including grades, degree completion (actual award of a degree) or dropping out, and to a lesser extent on likelihood of enrolment in higher education, expectations of attending and graduation from university or aspirations to additional qualifications. This paper contributes to the literature by providing evidence in favour of the reserve causality hypothesis that suggests that being overweight or obese in adolescence confers disadvantage to further educational aspirations, and hence lower educational attainment, which may hamper future employment opportunities.

We examine the relationship between weight status and educational expectations among adolescents aged 16-21 using a unique database for Spain. We control for a large set of observable determinants: cognitive and non-cognitive factors, family background and parents' involvement in children's education. This rich set of variables allow us to account for a high share of the unobserved individual heterogeneity bias quite common in studies not based on panel data. Our data also allow us to control for school unobserved heterogeneity via school fixed-effects. To instrument BMI, we use the average BMI of the same-sex classmates. Our instrument, which is based on the commonly used area-based instruments (e.g. Currie and Cole, 1993; Grabowski and Hirth, 2003; Lo Sasso and Buchmueller, 2004; Morris, 2006), perform quite well.

The estimates of the IV models are in line with results reported in previous studies that used alternative instruments such as genetic markers, weight status of the mother or individuals' past weigh status (von Hippel and Lynch, 2014; Benson et al, 2018). Our results confirm findings from previous studies that report inverse relationship between adolescent obesity and the likelihood of university enrollment and completion (Crusnoe, 2007; Fowler-Brown et al, 2010; Chung et al, 2011; von Hippel and Lynch, 2014; Benson et al, 2017; Cheng et al, 2017). As we do here, most of these studies also suggest that there exist gender differences in the educational attainment and the consequences of overweight and obesity are either greater in females or affect only girls. As in Crosnoe (2007) and Benson et al (2017), our results support the *selection* hypothesis. We observe lower expectations to achieve a university degree among adolescent girls with higher BMI, while this difference is not statistically significant for boys. However, when we test for the impact of BMI on the probability of attending high-school next year, or being currently enrolled in high-school (vs. lower vocational track), which is a necessary pre-condition to go to university, we observe an unambiguously significant negative effect of BMI for both boys and girls, though the effect is more sizeable for girls, almost double.

Fowler-Brown et al (2010) tried to explain the negative impact of obesity on university degree attainment by analyzing the future college expectations of subset of their sample. These authors claimed that overweight and obese individuals have lower expectation for college than their normal weight counterparts, a difference that disappeared in the analyses adjusted for demographic and socioeconomic covariates. This is the contrary to what we find, since the significance of the impact of BMI on expectations to obtain a university degree and the probability of attending college persists after controlling for a large set of individual and family controls.

Although our data allow us to control for a number of observable confounders and unmeasured school characteristics, we admit this study has some limitations. First, BMI is self-reported and may be subject to reporting bias. Nevertheless, it is the most widely used indicator to assess unhealthy weight status and is generally considered an appropriate one in children and adolescents (Krebs et al., 2007), despite some conflicting results showing that adolescents over-report height and under-report weight, and thus, under-report BMI (Gorber et al, 2007; Gil and Mora, 2010). The fact that the distribution of our BMI indicator exhibits the same distribution as the one observed for adolescents in other official surveys, suggests that still it is a robust indicator. Given that we do not classify students in our sample into weight categories, but use the continuous measure of BMI, we can assume that the potential measurement error bias, if there was any, does no affect our analysis because we use instrumental variables. Second, longitudinal study designs are better suited to explore causal relationships than our cross-sectional data. However, we control for peer effects by adding school fixed-effects, i.e. we account for the common characteristics of the school environment, which are not generally controlled for in the previous studies.

Despite these limitations, our study clearly demonstrates the effect of weight status on expectations and intentions of further education of adolescents in Spain, and reveals the influence of confounding variables. Unhealthy body weight seems to hamper girls' aspirations to additional qualifications more boys' aspirations. Our results add to the understanding of the causal relationship between overweight and obesity and educational expectations in the Spanish context, by providing new empirical evidence that supports the *selection* hypothesis. Currently, the number of studies testing for this hypothesis is remarkably scarce, though they seem to be taking off.

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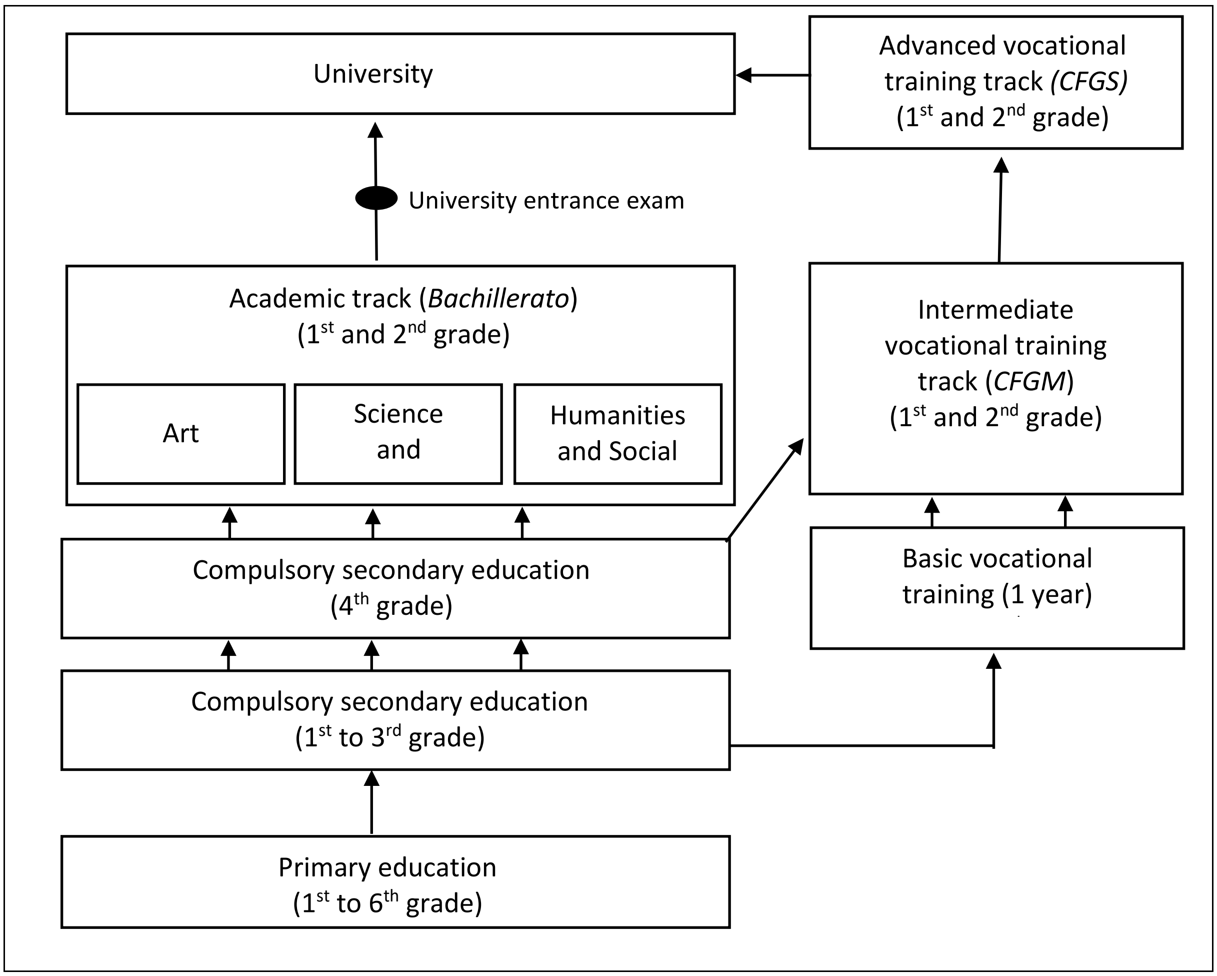
Figure 1

Stylized description of the Spanish educational system



Source: Adapted from the Spanish Ministry of Education

Figure 2

Density of the BMI in our sample (age 16-18)

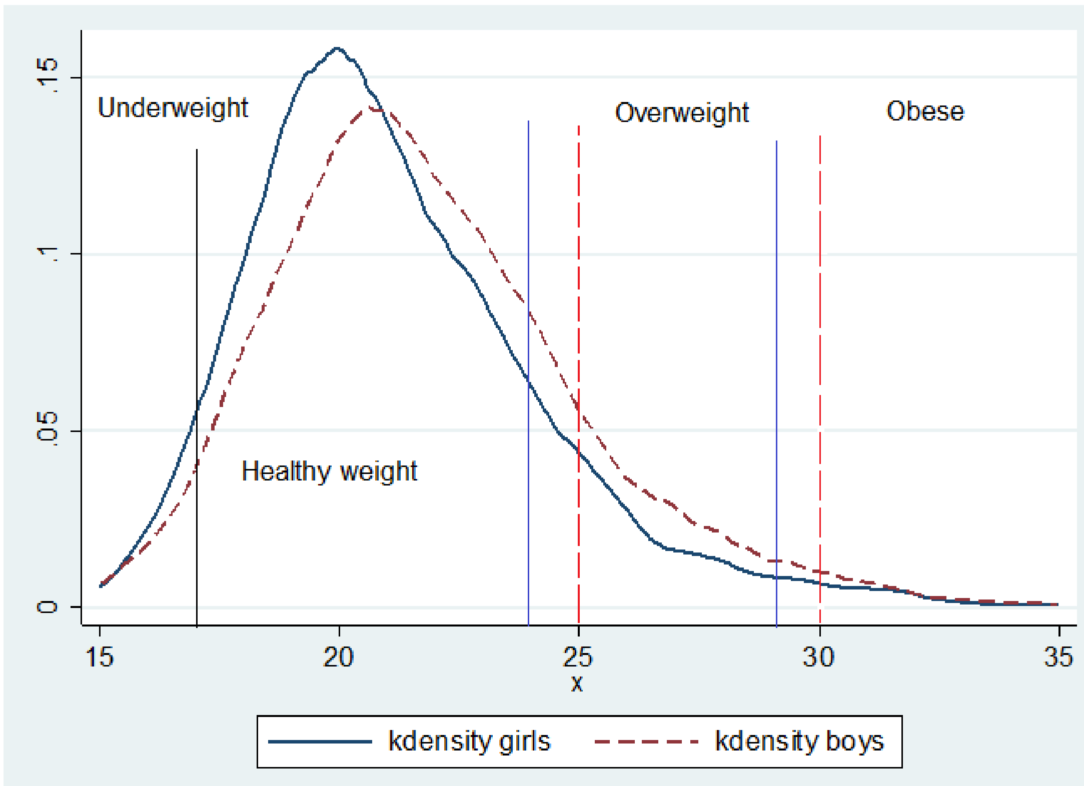


Figure 3

Comparison of the BMI's distribution between our data and the Health Survey of Catalonia

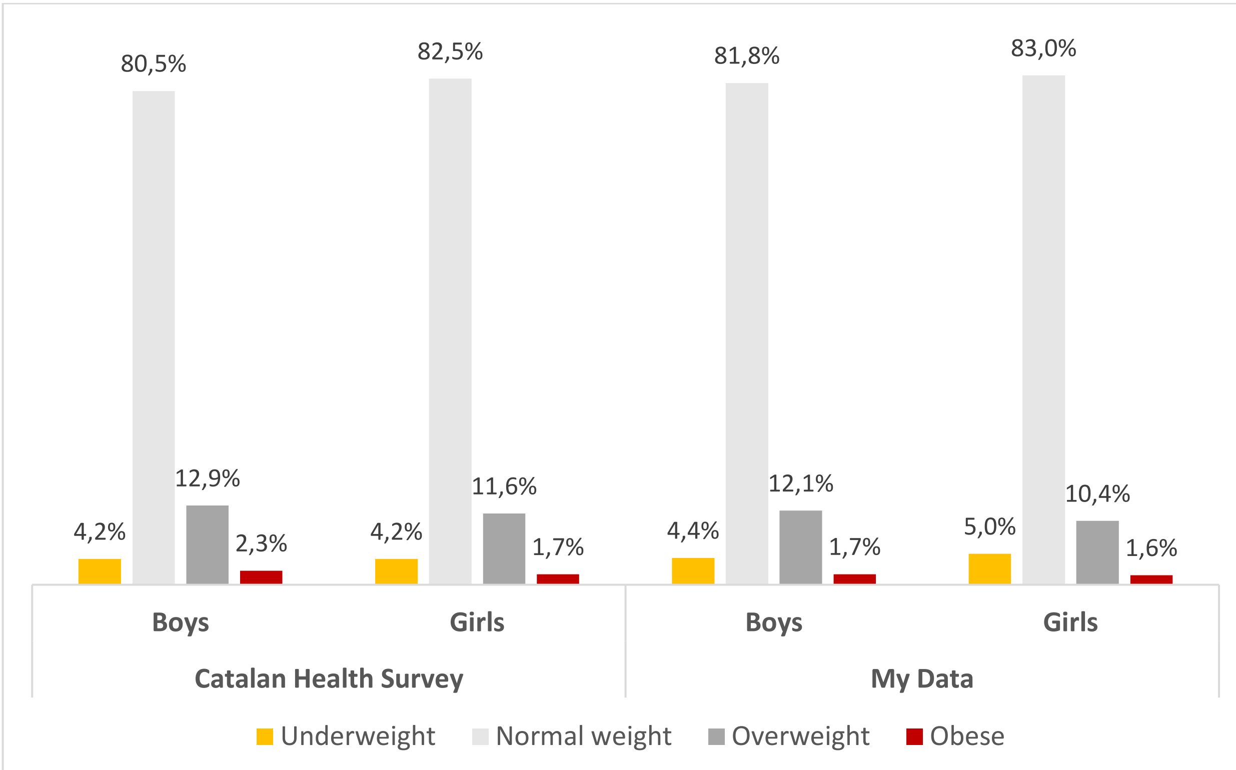


Table 1

Summary statistics of the outcome variables in our data compared with data coming from different sources

	Post-compulsory secondary education					
	Our data			Population statistics(1)		
	All	**Boys**	**Girls**	**All**	**Boys**	**Girls**
% attending high-school	65.6%	60.2%	70.2%	66%	60%	70%
% attending vocational track	34.4%	39.8%	29.8%			
	What are you going to study next year?					
	Our data			**Population statistics(1)**		
	All	**Boys**	**Girls**	**All**	**Boys**	**Girls**
Students in 4th grade ESO						
High-school	59%	54%	63%	66%	60%	70%
Lower vocational-professional track	33%	36%	31%			
Do not know	8%	10%	6%			
2nd grade high-school						
University	67%	62%	70%	75%		
Upper vocational-professional track	19%	22%	17%			
Do not know	10%	10%	10%			
Other	4%	6%	3%			
	Expectations achieving university degree					
	Our data			**PISA data**		
	All	**Boys**	**Girls**	**All**	**Boys**	**Girls**
Students in 4th grade ESO	56.3%	49.6%	62.6%	59.2%	55.1%	63.6%

Notes: (1) Population statistics are taken from administrative registers of the Regional Government of Catalonia

Table 2

Summary statistics of the outcome and control variables

	Boys		Girls	
	Mean	**s.d.**	**Mean**	**s.d.**
Expect to have university degree	0.52	0.50	0.65	0.48
Attend high-school next year	0.62	0.49	0.71	0.46
Healthy weight	0.79	0.41	0.79	0.41
Underweight	0.06	0.23	0.05	0.22
Overweight	0.15	0.36	0.16	0.37
BMI	21.30	3.38	21.00	3.12
Duration of the survey	28.02	10.07	28.55	10.68
Diagnosed learning handicap	0.10	0.31	0.08	0.27
Born in Catalonia	0.82	0.38	0.80	0.40
Born rest of Spain	0.03	0.16	0.02	0.15
Born abroad	0.15	0.36	0.18	0.38
Hours homework per day	1.43	1.18	2.10	1.25
Number of siblings (NS)	1.40	1.10	1.50	1.19
NS/(NS dropout)	0.08	0.25	0.11	0.27
Married	0.70	0.46	0.68	0.47
Divorced	0.22	0.41	0.23	0.42
Single	0.02	0.13	0.02	0.13
Widow	0.02	0.16	0.02	0.13
Cohabiting partner	0.04	0.20	0.05	0.22
Mother attend meetings school (1-4)	3.04	1.02	3.06	1.05
Father attend meetings school (1-4)	2.09	1.06	2.00	1.03
Mother helps homework (1-4)	1.70	0.80	1.82	0.87
Father helps homework (1-4)	1.60	0.76	1.66	0.81
Father university degree	0.15	0.36	0.15	0.35
Mother university degree	0.21	0.41	0.21	0.41
Both parents university degree	0.09	0.28	0.09	0.29
Observations	1,479		1,586	

Table 3
Determinants of the expectations to graduate from university and the intentions to attend high school

	Expectations graduate from university		Intentions to attend high-school next year		Currently attending high-school	
	Girls	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
BMI	-0.008**	-0.006	-0.007*	-0.010**	-0.007***	-0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)
Duration of the survey	-0.005***	-0.001	-0.006***	-0.003*	-0.002***	-0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Diagnosed learning handicap	-0.229***	-0.169***	-0.305***	-0.218***	-0.159***	-0.075***
	(0.044)	(0.045)	(0.044)	(0.046)	(0.025)	(0.026)
Born rest of Spain	-0.162**	0.022	-0.215***	-0.260***	0.025	-0.090*
	(0.075)	(0.085)	(0.075)	(0.087)	(0.042)	(0.048)
Born abroad	-0.062*	-0.150***	0.013	-0.106***	-0.089***	-0.101***
	(0.033)	(0.040)	(0.033)	(0.041)	(0.019)	(0.024)
Hours homework per day	0.054***	0.027**	0.052***	0.037***	0.028***	0.038***
	(0.010)	(0.012)	(0.010)	(0.012)	(0.004)	(0.006)
Number of siblings	-0.034***	-0.008	-0.054***	-0.039***	-0.017***	-0.002
	(0.011)	(0.013)	(0.010)	(0.013)	(0.006)	(0.008)
% siblings school dropouts	-0.043	-0.164***	-0.107**	-0.097*	-0.027	-0.060**
	(0.045)	(0.054)	(0.045)	(0.056)	(0.024)	(0.030)
Divorced parents	-0.022	-0.061*	-0.015	-0.091***	-0.039**	-0.019
	(0.029)	(0.033)	(0.028)	(0.034)	(0.016)	(0.021)
Single parent	-0.108	-0.251**	-0.062	-0.136	0.031	-0.085
	(0.092)	(0.108)	(0.095)	(0.114)	(0.058)	(0.082)
Widowed parent	0.110	-0.025	0.036	-0.026	-0.109**	-0.013
	(0.099)	(0.094)	(0.095)	(0.094)	(0.048)	(0.054)
Parents' involvement	0.013**	-0.006	0.012**	-0.013**	-0.002	-0.001
	(0.005)	(0.006)	(0.005)	(0.006)	(0.003)	(0.003)
Father higher education	0.147***	0.181***	0.092*	0.148***	0.086***	0.079***
	(0.053)	(0.054)	(0.051)	(0.054)	(0.020)	(0.024)
Mother higher education	0.181***	0.315***	0.176***	0.277***	0.028	0.056*
	(0.037)	(0.043)	(0.036)	(0.042)	(0.026)	(0.031)
Both parents higher education	-0.185**	-0.181**	-0.059	-0.139*	-0.040	-0.001
	(0.073)	(0.081)	(0.071)	(0.079)	(0.038)	(0.045)
Observations	1,380	1,287	1,294	1,166	1,380	1,287
R-squared	0.128	0.108	0.181	0.125	0.128	0.108
Number of schools	72	69	71	67	72	69
School fixed-effects	YES	YES	YES	YES	YES	YES

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4
Expectations to graduate from university

	(1)		(2)		(3)		(4)		(5)	
	Equation (5)		**Equation (7)**		**Under-identification**		**Weak identification**		**Sargan-Hansen**	
	Coef.	**t-value**	**Coef.**	**t-value**	**χ^2**	**p-value**	**F**	**SY (10%)**	**χ^2**	**p-value**
Girls										
OLS	**-0.008****	-2.00								
IV (BMI)	**-0.026****	-2.36	0.026**	2.19	175.86	0.00	200.69	16.38		
IV (BMI, Sleep duration)	**-0.026****	-2.36			175.93	0.00	100.31	19.93	0.30	0.58
Boys										
OLS	**-0.006**	-1.50								
IV (BMI)	**-0.020**	-1.54	0.013	0.96	119.68	0.00	130.98	16.38		
IV (BMI, Sleep duration)	**-0.018**	-1.38			124.37	0.00	68.26	19.93	1.04	0.31

*** p<0.01, ** p<0.05, * p<0.1

(1) Estimation of the effects of BMI on the expectations to graduate from university

(2) Endogeneity test. Estimation of the coefficient of the estimated residuals of (7) in equation (8). H_0: hk=0 (BMI is exogenous)

(3) Under-identification test. Test for the significance of the instruments. H_0: Instruments are not correlated with BMI

(4) Weak instruments test. H_0: Instruments are weak (Null hypothesis is rejected if F-value> SY (10%), where SY are Stock-Yogo critical values

(5) Test for the exogeneity of the instruments. H_0: Instruments are exogenous

Table 5
Intentions to attend high school next year

	(1)		(2)		(3)		(4)		(5)	
	Equation (5)		**Equation (7)**		**Under-identification**		**Weak identification**		**Sargan-Hansen**	
	Coeff.	**t-value**	**Coeff.**	**t-value**	**χ^2**	**p-value**	**F**	**SY (10%)**	**χ^2**	**p-value**
Girls										
OLS	**-0.007***	-1.75								
IV (BMI)	**-0.050*****	-4.55	0.049***	4.51	160.00	0.00	182.94	16.38		
IV (BMI, Sleep duration)	**-0.050*****	-4.55			161.76	0.00	91.91	19.93	0.05	0.82
Boys										
OLS	**-0.010****	-2.50								
IV (BMI)	**-0.030****	-2.31	0.020	1.54	110.57	0.00	121.15	16.38		
IV (BMI, Sleep duration)	**-0.028****	-2.33			116.05	0.00	63.87	19.93	0.55	0.46

*** p<0.01, ** p<0.05, * p<0.1

(1) Estimation of the effects of BMI on theintentions to attend high school next year

(2) Endogeneity test. Estimation of the coefficient of the estimated residuals of (7) in equation (8). H_0: hk=0 (BMI is exogenous)

(3) Under-identification test. Test for the significance of the instruments. H_0: Instruments are not correlated with BMI

(4) Weak instruments test. H_0: Instruments are weak (Null hypothesis is rejected if F-value> SY (10%), where SY are Stock-Yogo critical values

(5) Test for the exogeneity of the instruments. H_0: Instruments are exogenous

Table 6
Probability of being currently studying high-school (vs. vocational track)

	(1) Equation (5)		(2) Equation (7)		(3) Under-identification		(4) Weak identification		(5) Sargan-Hansen	
	Coeff.	**t-value**	**Coeff.**	**t-value**	χ^2	**p-value**	**F**	**SY (10%)**	χ^2	**p-value**
Girls										
OLS	**-0.007*****	-3.27								
IV (BMI)	**-0.056*****	-8.27	0.057***	9.10	216.25	0.00	244.89	16.38		
IV (BMI, practice sports)	**-0.056*****	-8.23			161.76	0.00	91.91	19.93	0.85	0.35
Boys										
OLS	**-0.003**	-1.25								
IV (BMI)	**-0.041*****	-4.74	0.041***	4.96	144.12	0.00	157.45	16.38		
IV (BMI, practice sports)	**-0.041*****	-4.78			142.96	0.00	78.00	19.93	0.39	0.53

*** p<0.01, ** p<0.05, * p<0.1

(1) Estimation of the effects of BMI on theintentions to attend high school next year

(2) Endogeneity test. Estimation of the coefficient of the estimated residuals of (7) in equation (8). H_0: hk=0 (BMI is exogenous)

(3) Under-identification test. Test for the significance of the instruments. H_0: Instruments are not correlated with BMI

(4) Weak instruments test. H_0: Instruments are weak (Null hypothesis is rejected if F-value> SY (10%), where SY are Stock-Yogo critical values

(5) Test for the exogeneity of the instruments. H_0: Instruments are exogenous