Body Weight and Gender: Academic Choice and Performance

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Abstract

This study examines the relationship between body weight and academic choice and performance, focusing on gender differences and using survey data from students at the University of Salerno in Italy. Our findings indicate a significant negative relationship between body weight and academic performance, particularly for female students. In our examination of BMI and field of study (i.e., science vs. the humanities), our results indicate that overweight/obese females are less likely than those of average weight to pursue scientific studies, and hence, more remunerative careers. The asymmetry of the findings between males and females suggests that during late adolescence physicality plays different roles according to gender.

Keywords: human capital; body weight; educational economics; microeconometrics.

JEL classifications: **I12; J24; I21; D01; C25.**

1. Introduction

In recent years, the negative consequences of being overweight or obese have been analysed from economic perspectives. Among them are direct consequences such as higher medical costs and indirect consequences such as labour market outcomes, mainly in terms of wages and employment (Averett, 2011). Previous studies have found a negative relationship between obesity and wages, with wage penalties being higher for women than for men (Register & Williams, 1990; Averett & Korenman, 1996; Harper, 2000; Cawley, 2000). Pagan and Davila (1997) found a statistically significant wage penalty for women but not for men, after controlling for the endogeneity of BMI. Regarding reasons for the wage differences, these authors cite that obese women tend to work in low-paying occupations and are excluded from higher income occupations. In later studies, similar gender differences have been confirmed regarding wages (Cawley, 2004; Cawley,

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Grabka, & Lillard, 2005; Garcia, Villar, & Quintana-Domeque, 2007; Conley & Grauber, 2007; Brunello & d'Hombres, 2007) and occupation status (Morris, 2006; Conley & Grauber, 2007).

Mocan and Tekin (2011, p.350) have recently suggested that being obese or overweight may affect an individual's wages through different channels: 1) lower labour productivity due to physical limitations; 2) discrimination by employers or customers, regardless of productivity; 3) lower wages because employers assume higher health care costs for obese workers; 4) diminished cognitive function might lower productivity; and 5) self-esteem issues might cause obese workers to choose less ambitious working positions.

Building on the work of Cawley, Sabia (2007) finds that the negative economic impact of being overweight cannot be fully understood without examining the deeper influences of human capital accumulation: "if increased body weight reduces academic performance of adolescents or young adults, then the obesity-wage gap estimated by Cawley may reflect only part of the economic harm of obesity" (p. 73).

Subsequent to Sabia's work, other studies have discovered a significant negative relationship between education and weight (Barone & O'Higgins, 2010; von Hippel & Lynch, 2014; Lu, Chou, & Lin, 2014). Von Hippel and Lynch proposed two likely explanations for this relationship - selection and causation[1]. In a national representative sample of American teenagers these authors also found that selection is mainly responsible for the education gradient in BMI. According to Averett (2014), "despite numerous studies finding that obese people receive lower wages and have a lower probability of employment, it is not for sure whether the lower wages, particularly for obese women, are due to employers' subjective antipathy towards obese women, due to statistical discrimination, or due to real differences in productivity. The link between education and obesity also needs further study. There is mixed evidence on whether obese children and adolescents have lower academic outcomes, thus limiting their future productivity". In this respect, the line of research by Sabia (2007) to consider the link between education and being overweight/obese during the human capital accumulation period takes into account the role of gender, which is important in order to understand the negative impact being overweight can have on human capital accumulation and later in the labour market performance in terms of wages and occupation. More recently, in this line of research, Sabia and Rees (2015) have also analysed the role played by psychological factors according to gender, finding

[1] Selection refers to the phenomenon that students with a high BMI are less likely to plan for or complete higher levels of education; causation refers to the phenomenon that education confers social and economic benefits that help adults maintain a healthy BMI.

that body weight leads to decreased self-esteem among female but not male students.

In Italy, the adverse economic impact of obesity in terms of wages and working conditions has not been fully explored[2] because only recently has being overweight become a health and social problem. According to the OECD (2012a), obesity rates among adults in Italy are low relative to most OECD countries, but these rates are high among children (one in three children is overweight, representing one of the highest rates in the OECD) and different throughout regions of Italy (Brunello & Labartino, 2014): obesity rates are higher in the South than in the North of the country. Despite the low rates among adults, Garcia Villar & Quintana-Domeque (2007) and Devaux-Sassi (2012) found that a wage penalty for obese women in the labour market does exist in Italy. Even if obesity in Italy still mainly affects children and adolescents, it is interesting to study how being overweight/obese could interfere with the academic performance of male and female young adults who are still in their human capital accumulation period. To this respect, Barone and O'Higgins (2010) found that obese and overweight adolescents are more likely to drop out of school.

The present study examines the relationship between body weight and academic goals, focusing on gender differences and using survey data from students at the University of Salerno in southern Italy.

An important feature of our sample is that it is composed of students from several disciplines (i.e., educational science, the arts, foreign languages, engineering, pharmacy, computer science, and others). This diversity allowed us to investigate the existence of a relationship between BMI and the study disciplines chosen by women (particularly, the choice between the sciences and humanities). This issue is particularly interesting because women are traditionally more reluctant to study math and science (Schneeweis & Zweimuller, 2012). Moreover, in the last twenty years, most OECD countries have registered a decreasing trend in enrolment in scientific programmes. Investments in scientific studies are important not only for economic growth but also, from a microeconomic perspective, to increase individual probabilities of employment and early earnings (Machin & Puhani, 2003; Buonanno & Pozzoli, 2009; Maestri, 2013).

As observed in the OECD data about university graduates by field of study (OECD, 2012b), presented in Figure 1, there are large gender differences in the subjects that young men and women study at university in Italy: females tend to prefer health and welfare subjects while males prefer engineering, manufacturing and construction.

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[2]Wage differentials and different unemployment rates for different education levels, however, have been found in several studies (Addabbo & Favaro, 2011).

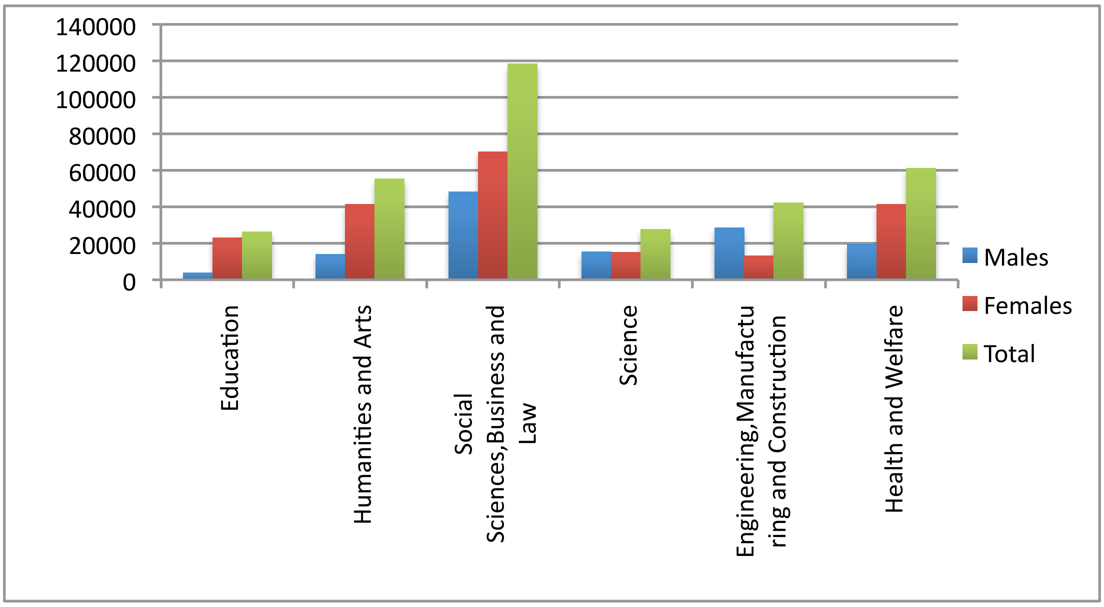

Figure 1.University graduates in Italy by field of study (OECD Database, 2012)

Overall, in Italy, women enrol and graduate more than males but are more likely to graduate from humanistic fields of study. “Such differences in subjects studied at university both reflect and influence different career choices, contributing to occupational segregation in the labour market”(OECD, 2006, p.13).

Our main results confirm the existence of a significant negative relationship for females between academic results(regarding both scores and the number of exams) and BMI, after controlling for unobserved heterogeneity. The novelty of this study, however, is that overweight females are also more likely to choose humanistic studies.

Our paper is structured as follows: Section 2 reviews previous studies on obesity and educational achievement and presents the theoretical background and our research hypothesis; Section 3 describes our empirical model and data; Section 4 presents our empirical findings; and Section 5 describes our conclusions.

2. The relationship between obesity and educational achievement

2.1 Previous studies

The relationship between body weight and educational achievement has been analysed in disciplines such as psychology, sociology, medicine and, more recently, economics (Truong & Sturm, 2011).

According to psychologists and sociologists, being overweight can affect educational achievement by influencing an individual's self-esteem and body image (Puhl, 2011). At the same time, body weight and educational achievement can be influenced by additional factors such as "future orientation," the individual's willingness to invest in his or her future health, income and social success (Duncan et al., 2007; Sutin, Ferrucci, Zonderman & Terracciano, 2011). Using data from the National Longitudinal Survey of Youth (NLSY97) and tracking self-reported BMI from adolescence (age 15) through young adulthood (age 29), Von Hippel and Lynch (2014) studied the relative importance of selection and causation to explain the education gradient in BMI, or the reason why more educated adults tend to have lower BMI and a lower risk of being overweight and obese than those with less education. According to the selection hypothesis, high-BMI adolescents tend to become less educated adults because of family background, social psychology factors and individual dispositions and traits; according to the causation hypothesis, education has an impact on health behaviours. The results of their analysis show that, among adolescents, those with a high BMI are less likely to complete higher levels of education, confirming the selection hypothesis that boys and girls with a high BMI tend to come from disadvantaged families and perform poorly in academics. Moreover, girls suffer from bullying, health problems and early pregnancy. Their results also show that among young adults the education gradient in BMI is mostly due to selection, not to causation.

According to economists, individuals rationally invest in human capital through education, training and health behaviours, and their decisions are optimal responses to their initial talents and preferences. Grossman (2000) has identified three basic mechanisms through which health and schooling may be related. First, schooling may improve health by improving allocative and productive efficiency. Second, better health may facilitate education. Third, factors such as physical activity, time preferences and parental characteristics may influence health and study habits. In this paradigm, associations between education and body weight reflect omitted individual variables, particularly ability and preferences (Becker, 1964). Individuals who do not discount the future more heavily invest less in their education and health (Fuchs, 1982, 2004; Becker & Mulligan, 1997; Fersterer & Winter-Ebmer, 2003; Castillo, Ferraro, Jordan, & Petrie, 2011; Eide &

Showalter, 2011; Dodd, 2014), leading to a correlation between high BMI and educational outcomes (Komlos, Smith, & Bogin, 2004; Smith et al., 2005; Borghans & Golsteyn, 2006; Zhang & Rashad, 2008).

Overall, most studies in this field have found that the relationship between obesity and educational achievement is negative. Taras and Potts-Datema (2005) have reviewed nine papers examining the link between obesity amongst school-aged children and school performance and have demonstrated that being overweight and obese is associated with poor levels of educational achievement.

More interestingly, although some studies in the US have concluded that overweight and obese children aged 5-12 (Kaestner & Grossman, 2008, 2009) and teens (Kaestner, Grossman, and Yarnoff 2009, 2011) have levels of attainment that are approximately the same as those of average weight children, other studies have reported gender differences as well as different patterns across genders. In line with the results of Datar, Sturm, and Magnabosco (2004), this negative association is stronger for boys than girls (Cawley & Spiess, 2008) in children ages 2-3, in older children (Wendt & Kinsey, 2009), adolescents and young adults (Sabia, 2007; Crosnoe, 2007). The association is stronger for young women than for young men.

Building on the obesity-wage findings of Cawley (2004), Sabia (2007) has analysed the relationship between adolescents' (14-17 years) body weight and academic performance, finding a negative relationship among white females, but not among males and non-white females. The author suggests that this negative relationship might have three possible explanations: 1) differences in human capital accumulation; 2) a common unobserved factor, such as self-esteem, which is influenced by body weight and influences academic performance; 3) discrimination against obese white females at school. Crosnoe (2007) has also found gender differences, more precisely a negative relationship between adolescent obesity and subsequent academic enrollment of young women.

More recently, Okunade, Hussey, and Karakus (2009) have estimated the impact of being overweight or obese for adolescents in the US and completing high school on-time and have found that there is gender difference, a significant negative effect for females but not for males, as well as race differences among females, an effect that exists among Asian, Caucasian and Hispanic females, but not among African American females. Barone and O'Higgins (2010) have found a strong positive association between obese adolescents (14-17 years) and school dropout rates in southern Italy. Their results show that obese girls suffer more serious consequences than do obese boys.

In summary, different fields of research reveal that the relationship between obesity and educational achievement is negative and that obesity has an impact on educational achievement according to gender or race. In this respect, obesity would also appear to affect the labour market. Cawley and Spiess (2008, p. 394) observed that the higher wage penalty for obese women in the labour market might be due to the observation that obesity lowers human capital accumulation more for women than for men; according to the authors, discrimination by teachers, classmates or day care providers is not sufficient to explain the association between obesity and academic performance (2008, p. 395).

2. 2 The research question and analytical framework

The aim of this paper is to analyse the impact of body weight and obesity on educational achievement and human capital accumulation. Physical appearance might play a key role in influencing educational achievement in the period from adolescence to young adulthood (12-13 years to 18-20 years for females, and 14-15 years to 20-22 years for males). If women are more sensitive to their physical appearance than men during key human capital accumulation periods such as adolescence, obesity might produce different educational outcomes both across and within genders. Across genders, lower academic achievement for females might be a result of the impact that obesity could have on self-esteem, as suggested by Sabia (2007).Within gender, this mechanism might explain the lower academic achievement of obese females compared to those of average weight.

Here, we consider the potential effect of body weight on the academic performance[3] of a university student and, as a consequence, on the individual's career perspectives. The main hypothesis is that better academic performance raises the growth of an individual's human capital h such that in the future, because of this human capital gain, a student with better academic performance will receive a higher wage W_{BP} in the labour market than a student with worse academic performance W_{WP}:

$$W_{BP} = (1 + h)W_{WP} \quad (1)$$

with

[3] As explained in more detail in the next section, we measure academic performance through the number of exams passed per year, the mean score of the exams, and the chosen field of study.

$$h = ae \quad a > 0 \tag{2}$$

and

$$e = \frac{\vartheta}{1 + \mu E} \quad \vartheta, \mu > 0 \tag{3}$$

In Eq. (2), the human capital growth h depends on the combination of the individual's academic effort, e, and the individual's ability a (where ability may include individual and/or school quality, family relations or income, and other factors that complement individual effort but do not depend on it). With this formulation, our work follows that of Barone and O'Higgins (2010) who consider the role of obesity in influencing school dropout rates. The formulation may be thought of as a simplified version of the education production function suggested by Hanushek (1986).

In Eq. (3), obesity, E, may interfere with academic effort. A person's tendency to gain weight is

$$E = kC - dA \tag{4}$$

This formulation, assumed to be linear for simplicity, is closely related to the concept of energy balance (Rashad, 2006), where C is the individual's calorific intake, and A is physical activity. This equation has been modified to take into account that the tendency to gain weight (E>0) is determined by factors affecting C and A, as well as by those related to the adolescent's physical constitution that determines the values of k and d.

Eq. (3) suggests that obesity and being overweight could have two consequences:

a) being overweight and obese may negatively affect the efficiency of the academic effort e according to the size of the individual specific parameter μ and, lowering the human capital growth h, he/she will reduce his/her human capital gain in the labour market. Eq. (3) is consistent with the findings of a negative impact of BMI on academic performance (Sabia, 2007);

b) if females are more sensitive than males to their physical appearance during late adolescence, then μ would be higher for females than for males (i.e., $\mu_f > \mu_m$). Thus, obesity during adolescence could more negatively affect females than males in respect their academic effort and human capital growth. Averett (2011, p. 549) has recently reported that "the finding that labour market penalties of obesity are concentrated among women deserves more scrutiny". Are women more sensitive to their appearance than men? Mocan and Tekin (2011, p.378) provide results indicating that "body weight has an independent impact on self-esteem controlling for a host of personal attributes, including education, health status, and family background characteristics. Specifically a negative influence for females and black males, not so strong for white males." Eq. (3) is consistent with the finding that among adolescents, the relationship between BMI and educational attainment is stronger for young women than for young men (Sabia, 2007; Crosnoe, 2007:Sabia& Rees, 2015).

3. Empirical model and data

3.1 Model: the empirical specification

The most used method in the literature to assess the impact of body weight and obesity on educational achievement (Sabia, 2007) is the estimation of an OLS equation, where the dependent variable is a measure of academic achievement while the indicator of body weight is included among the correlates.

In our empirical model, the dependent variable indicates the number of exams passed (deflated by the number of years of enrolment), taking into account the difficulties of each exam (measured by the formative credit units[4]) and the score reported. Hence, we estimate a Probit model as follows:

$$P_i = X'\beta_{0i} + BMI\ \beta_{1i} + \eta_i \qquad (5)$$

The dependent variable is a dummy variable, equal to 1 when the mean score and the number of credits are equal to or higher than the median value among classmates[5], and equal to 0 otherwise.

[4]For example, exams demanding more effort are given 10 CFU (Formative Credit Units).

[5]Choosing median values for each class takes into account the difficulties in characterizing different disciplines.

A specific problem in the estimation procedure is that, if some unobserved factors were correlated with both body weight and educational achievement, then the estimated coefficient on BMI would be biased (endogeneity bias). For example, low future planning may encourage unhealthy lifestyles such as poor academic performance. Similarly, a disadvantaged family background may influence both obesity and education. Reverse causality is also likely: students may compensate for a lack of positive academic results by eating more food; alternatively, one could argue that people who spend much of their time studying are more likely to neglect body care.

When using cross sectional data, the standard method to account for endogeneity relies on the use of instrumental variables (IV model)[6], correlated with body weight but uncorrelated with academic achievement. Satisfying this identification assumption, however, represents the main difficulty of the IV estimation.

Sabia (2007) found evidence of endogeneity by relying on measures of parental obesity as an instrumental variable, and fixed effect estimates have also been provided but were consistent with the OLS results[7]. Similarly, Barone and O'Higgins (2010) found a consistent negative relationship between adolescent body weight and the probability of withdrawing from school. Their results supported the hypothesis of exogeneity, though the validity of the instrumental variables used (e.g., measures of both parents' education) is unclear.

The IV approach is used to test for the endogeneity of student body weight in the Probit estimates. Satisfying the identification assumptions of IV, we rely on the use of the instrumental variables, correlated with body weight but uncorrelated with student achievement: two dummies for the habit of controlling one's own body weight, a dummy for the habit of eating food prepared at home during the breaks at university (instead of ready-made snacks), and a dummy equal to one if his/her own family often eats sweets. Some concern remains about the choice of the instruments: a plausible line of reasoning could be that the self-control required to have healthy habits and family background could influence both academic achievement and the BMI score. However, the choice of the instruments is determined by the available survey-data, and tests for

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[6]Fixed effects or lag variables are sometimes introduced to alleviate problems associated with the potential endogeneity of regressors; a brief review concerning estimates of the causal relationship between obesity and wages, or between obesity and mortality has been addressed by Brunello, Michaud, and Sanz de Galdeano (2008).

[7]Sabia used the Lewbel IV approach, relying on heteroskedasticity as an identification assumption. Lewbel IV estimates are consistent with OLS estimates.

the validity and weaknesses of the instruments, as well as tests for the endogeneity of body weight, have been undertaken.

Given that different fields of study imply both different levels of effort and different career perspectives, we further investigated whether and to what extent body weight also influences the choice of academic coursework. More specifically, we estimated the following Probit equation:

$$H == Z'\delta_{0i} + BMI\ \delta_{1i} + \nu_i \qquad (6)$$

The dependent variable is a dummy variable, equal to 1 when the individual chooses a humanities discipline (vs science) and equal to 0 otherwise. Z is a vector of individual characteristics (i.e., age, gender, and family background, among others).

According to the literature on this topic, scientific studies require more effort and ability because higher risks of drop out are observed (Buonanno & Pozzoli, 2009; Maestri, 2013). At the same time, scientific disciplines imply higher returns. In this regard, data supplied from the Italian National Institute of Statistics (ISTAT) show that the average monthly earnings and employment probabilities for graduates in engineering are equal to € 1352 and 0.914, respectively; for graduates in the humanities, they are equal to approximately € 947 and 0.628[8], respectively. Data from AlmaLaurea[9] (2014) demonstrate that, within the first five years after degree completion, graduates in the arts and foreign languages face the highest unemployment rates (19.3% and 13.2%, respectively), while the group with the lowest unemployment rate is science graduates (3.5%).

The choice of the academic course is particularly relevant for women. Machin and Puhani (2003) report that the choice of degree explains 24% and 30% of the gender gap in Germany and in the UK, respectively. Schneeweis and Zweimuller (2012) claim that women are reluctant to study math and science and this is the main cause of their traditional segregation in non-technical occupations; moreover, this circumstance implies a waste of human resources in that female students choosing technical studies perform better than males (Webbink & Ooosterbeek, 1997). In this respect, it is also important to note that, in 2005, the Italian government launched a policy to promote the study of science at the university by introducing extra-

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[8]See Brunello and Cappellari (2005) for further details.

[9] AlmaLaurea is an association among most Italian Universities, promoted by the Government to collect data about the main outcomes in the University context (number of people graduated by year, probabilities of employments, etc.).

curricular activities in the secondary schools, however, this policy did not have an effect on females (Maestri, 2013).

3.2 Data

The data were collected at the University of Salerno at the beginning of the first term of academic courses in two different years: October–November 2013 and October–November 2014. We submitted our questionnaire to students attending second-year main courses[10]. Most students in our sample are 20 years of age.[11]

A distinct feature of our sample is the heterogeneity of the students with respect to their careers perspectives as they come from different disciplines: sociology, arts, foreign languages, primary teacher education, computer science, management engineering, civil engineering, mechanical engineering, pharmacy and herbal sciences.

The students were asked questions ranging from information about their demographic and family background to individual habits, health status, previous education and academic motivation.

The sample used to estimate Eq. (5) is described in the columns of Table 1, columns I-II. After excluding observations with 'missing' values for the explanatory variables, the final sample included 774 males and 1183 females (overall, approximately 2000 students[12]). Academic achievement is a measure of both the number of formative credit units (CFU)/years of enrolment and exam scores. More specifically, the dependent variable is created as follows: first, we calculate the median number of credits (per year) and the

[10]Unfortunately, we have no information about the socio-demographic and physical characteristics of the students who did not attend: we tried to address this issue by recruiting students who attend main courses (i.e. those with the highest rates of attendance) at the beginning of the second academic year (when the rate of attendance is still high). Typically, students who do not attend lectures are those who are less motivated, with a lack of positive academic results; hence, one could argue that their exclusion from the sample might negatively bias the relationship between BMI and academic achievement. However, we are confident that the sample selection issue is not relevant to our aim in that i) we mainly focus on gender differences and ii) the probability of withdrawing from the university (or of not attending lectures) should not be affected by gender differences (as confirmed in data collected from different courses of study).

[11]85.65% of the sample includes second-year students.

[12]Overall, about 2200 students were interviewed. We have investigated the presence of sample selection bias by regression of the probability of no response on variables observed for the whole sample: gender, course of study and age, and the presence of the professor in class during questionnaire administration (e.g., at the beginning of the lesson or during the break). We did not find significant evidence of self-selection bias (results available upon request).

median exam score reported by the students in the same course of study; hence, each student is considered to be successful when he/she has reported both a number of credits (per year) and an overall score equal or above the median values in his/her course of study. We use the number of credits instead of the number of exams because the credits also reflect the grade of difficulty of each exam.

Columns III-IV report the main descriptive statistics of the sample used to analyse the probability of being enrolled in a humanities discipline (Eq. 6), overall 805 males and 1287 females; the percentage of the sampled students enrolled in a humanities discipline[13] was higher among female students (66.74%) and decreased significantly among men (approximately 18.68%).These figures are in line with the data from the University of Salerno for the 2013-2014 academic year (in fact, the percentage in humanities was approximately 69% of females and 20%of males).

Our data are also in line with the national data in that the percentage of females enrolled in the Italian University is higher than the percentage of males, and females are more likely to enrol in non-scientific faculties. According to the Ministry of Education data, in the academic year 2012-2013, 56.74 of university first year students were females, and among the scientific and humanistic faculties, once again, the percentage of female students was higher (43%) than the percentage of males (17%)[14]. Hence, at a national level, the choice of humanities is lower, which is not surprising given that in the South of Italy the public sector (in particular, the scholastic sector) offers the best employment prospects[15].

Let us now consider the most important independent variable of our study: body mass index (BMI). This is calculated as body weight/(height)^2. Self-reported measures of body weight and height have been largely analysed in the literature, and previous studies have highlighted that biases in self-reported responses vary with age (Sagna et al., 2013; Himes & Faricy, 2001), country (Krul, Daanen, & Choi, 2011), education (Sagna et al., 2013), and especially with gender (Danubio et al., 2008). More specifically, Danubio et al. (2008) have reported statistically significant under-reporting of weight and over-reporting of height for two samples of university students in Italy (at the University of Aquila and the Sapienza University of Rome);

[13]The following disciplines are in the humanities: sociology, arts, foreign languages, educational science, and primary teacher education.

[14] More specifically, in the academic year of 2012- 2013, in Italy, the percentage of first year university students enrolled in social and health faculties other than in sciences and humanities was 1.426.106 (809.179 females and 616.927 males); 152.596 females and 256.108 males were enrolled in scientific field of studies compared to 52312 males and 198772 females enrolled in the humanities.

[15] It is important to note, however, that, considering the University of Salerno, we included sociology in the humanistic field whereas, in the national statistics, sociology is included in the social sector not in humanities (see also note 14).

however, gender is the only characteristic systematically related to BMI misreporting amongst university students in Italy. We performed our analyses for males and females separately[16] so that any misreporting related to gender should not affect our results.

Family background is described by the parents' education. We note that the percentage of graduated parents is lower among female students such that one could argue that females are more motivated to study independently from their family background. Two additional variables reflect the students' family environments (i.e., whether their parents or other family members had been involved in caring for them when they were children), namely the variables "homework help" and "tales." It is interesting to note that males are given more care by their family members. Finally, a low (though not negligible) percentage of students suffer from chronic diseases that interfere with academic effort.

4. Results

Table 2 reports our estimates according to gender. The dependent variable is academic performance. Such a variable should signal individual capacities and motivations: we expect that clever students take a high number of exams and are likely to graduate within three years (e.g., the regular term of the course of study) with high scores [17].

Our estimates control for several potential predictors of educational attainment (parents' schooling and health, among others). Father's education has the expected impact on educational achievement only for females (a statistically significant positive effect); one explanation for the low impact of family background could be the low heterogeneity of the sample in this respect (all are university students coming from the same geographical area[18]). The variable "tales" has a statistically significant impact only for males.The variable documenting individual attitudes to schooling (i.e., the variables "attending courses") predicts educational attainment for both samples. Finally, the variable "health problems" that prevent intensive study is statistically significant only at 10% for females.

[16]In previous estimates, we adjusted the self-reported BMI values according to the relationships estimated by Danubio et al. (2008)[16] to account for misreporting bias; such correction, however, did not affect our main results.

[17]Less motivated students, with zero or few exams, are more likely to withdraw from university or take more years to graduate. In both cases, it is expected that they would obtain lower positions in the labour market than more applied students.

[18] In previous estimates, we controlled for family socio-economic background (e.g. parents' occupational status and homeownership) but we did not find any statistical significant impact on the explanatory power of the model.

Our main research question in Table 2, however, relates to the impact of body weight on education: are young adults with higher BMIs more likely to perform worse academically than those with lower BMIs?

For female students, the coefficient estimated for BMI is negative and statistically significant at the 5% level: the average marginal effect[19]indicates that a one point increase in BMI will produce a 1% decrease in the probability of good academic performance. For males, however, we find evidence of a statistically significant relationship between weight and academic performance only at the 10% level; the marginal effect is equal to -0.007 only.

The finding of a stronger impact among females, in our opinion, reinforces the hypothesis that psychological factors are likely to influence the relationship between body weight and education (on this point see, Barone and Nese, 2014; Sabia and Rees, 2015).

One must be cautious in interpreting estimates causally, however, because of a likely endogeneity bias; the impact of weight on academic achievement might lead to biased estimates in cases of reverse causality (i.e., academic performance might affect obesity) or if unmeasured characteristics influence both body weight and academic performance. In our study, the direction of causation from weight to academic performance seems to be more realistic, as we are observing academic results at the beginning of the second year of university, whereas being overweight occurs over time. This type of reasoning, however, does not exclude the likelihood of endogeneity. Therefore, we controlled for several explanatory variables to reduce the possibility that weight is influenced by other factors affecting both weight and academic results (i.e., parental background and health). We have tested for endogeneity, relying on several measures of healthy habits as instruments. These measures are not significant in the academic achievement equation but they are significantly correlated with individual BMI; the estimated coefficients and F-statistics on the instruments, reported in Table 3, suggest little evidence for weak instruments for females. Over-identification tests and exogeneity tests are reported in the last rows in Table 2, and they suggest a failure to reject the null hypothesis of exogeneity and of the validity of the instruments at the conventional significance levels.

Overall, our findings confirm previous overweight-education evidence (Sabia, 2007; Sargent &Blanchflower, 1994; Cawley, 2004; Crosnoe & Muller, 2004). The results are also consistent with recent

[19]The average marginal effects are computed as the means of the marginal effects evaluated at each observation.

overweight-wage studies (Pagan & Davila, 1997; Cawley, 2004) that found wage penalties for overweight women.

In Tables 4a and 4b, we report the estimates of the parameters in Eq. 6. More specifically, we examine whether BMI affects the choice of a humanities discipline (vs science), and we find a positive and a statistically significant relationship for the female sample only. It may be that more confident and academically oriented females are more likely to choose more ambitious careers, but being overweight is still relevant: a one point increase in BMI produces about a 1% increase in the probability of choosing humanities disciplines over those in science . When we control for previous scholastic performance (the type of diploma and the score reported at high school graduation), the relationship is no longer significant. To this respect, one may argue that the decreasing participation rates in scientific studies registered in most OECD countries in the last decades could be due, on one hand, to a high risk of drop out in the scientific courses and, on the other hand, to reduced academic selection correlated to an increasing democratisation and expansion of the university system in most developed western countries (Convert, 2005; Maestri, 2013).

The opposite evidence is reported for males - although the coefficient is significant only at the 10% level- thus confirming that, during late adolescence, physicality plays different roles according to gender: hence, again, one could argue that psychological or cultural factors shape the relationship between academic goals and BMI. This result, however, requires further investigation since the percentage of males enrolled in the humanities in the sample is very low (19%).

Finally, over-identification tests suggest a failure to reject the null hypothesis that the instruments are valid (at the conventional significance levels) for females only ; the results in the last line of Table 4 also suggest that the null hypothesis of exogeneity cannot be rejected at the conventional significance levels.

5. Concluding remarks

Taking into account the economic consequences of obesity highlighted in the literature (Cawley, 2004), this study investigates the relationship between body weight and academic patterns at the University of Salerno, with a specific focus on gender differences.

Consistent with previous studies (Sabia, 2007) and in contrast to others (Kaestner et al. 2009, 2011), our findings indicate a significant negative relationship between body weight and academic performance, specifically among female students. We also offer discussions and formal tests for the possible endogeneity of obesity in the individual academic patterns and the results suggest that the relationship between economic performance and body weight is causal; however, some perplexities remain about the instruments used.

We also produce new evidence about the relationship between BMI and the choices of fields of studies (i.e., in the humanities versus in science), and hence, between individual BMI and career perspectives.

Previous evidence reports that females are more reluctant to study math and science and suggest that this is the likely reason for their representation in non-technical occupations. Our results indicate that being overweight and obese further discourage females(and not males) from choosing scientific studies, thus reinforcing the gender gap in terms of wages and working conditions. The positive relationship between BMI and the choice of a humanities discipline (vs science), however, is no longer significant when we control for previous scholastic performance. This result is not surprising taking into account that scientific studies imply a high risk of drop out (i.e., it has been argued that the decreasing rate of scientific enrolments observed in the last twenty years could due to reduced academic selection in most OECD). Hence, we hope that this work contributes to the understanding of whether adverse economic impacts of being overweight/obese in the labour market are due to discrimination or due to real differences in human capital (Sabia and Rees, 2007; Averett, 2014).

TABLE 1 - Summary statistics				
	I - Males	II - Females	III - Males	IV - Females
	Mean (std dev)	Mean (std dev)	Mean (std dev)	Mean (std dev)
BMI	23.968 (0.145)	21.860 (0.095)	24.013 (0.146)	21.829 (0.090)
Homework help	0.0338 (0.017)	0.433 (0.014)	0.339 (0.017)	0.437 (0.014)
Tales	0.209 (0.015)	0.406 (0.014)	0.209 (0.014)	0.411 (0.014)
Age	20.772 (0.067)	20.643 (0.053)	20.857 (0.067)	20.768 (0.060)
Attending courses	3.601 (0.021)	3.572 (0.017)	3.586 (0.021)	3.556 (0.016)
Upper secondary school's score	82.861 (0.397)	82.825 (0.312)	82.619 (0.389)	82.802 (0.300)
	%	%	%	%
Academic achievement	34.24	39.48	32.68	35.98
Humanities	18.60	68.98	18.88	66.74
Mother's degree	22.61	14.29	23.11	14.76
Father's degree	21.58	16.40	21.61	16.63
Liceo	69.64	61.62	69.19	62.47
Scientific liceo	90.05	52.49	89.04	53.30
Ill	13.95	16.40	14.16	16.39
Weight control(never)	15.12	9.55	14.91	10.41
Weight control (sometimes)	56.85	54.27	57.14	54.16
Weight control (very often)	28.04	36.09	27.95	35.35
Home food (dummy=1)	56.85	65.51	56.52	65.58
Home food (dummy=0)	40.05	32.21	40.37	32.17
Number of observations	**774**	**1183**	**805**	**1287**

Legend: **BMI**: weight/(height in cm)^2; **homework help**: variable ranging from 1to 5 if he/she received help with homework by his/her parents or someone else in the family (1=every day; 5=never); **tales**: variable ranging from 1to 5 if his/her parents or someone else in the family told him/her fairy tales (1=every day; 5=never); **attending courses**: varying from 1 (usually) to 5 (never), the variable indicates whether the student usually attended courses in the previous academic years ; **upper schooling's score**: score reported at the upper secondary school diploma (ranging from 60/100 to 100/100); **academic achievement**: dummy equal to 1 when both the mean score and the number of credits are equal or higher than the median value among the classmates, 0 otherwise; **humanities**: dummy equal to 1 if he/she is enrolled in a humanities discipline (sociology, arts and philosophy, school of education), 0 otherwise (computer sciences, engineering, chemistry); **mother's (father's) degree**: dummy equal to 1 if his/her mother (father) is graduated;**liceo**: dummy equal to 1 if he/she attended a liceo, equal to 0 otherwise; **ill:** dummy equal to one if he/she suffers from chronic diseases that makes more difficult to study, equal to 0 otherwise; **weight control (never)**: dummy variable =1 if he/she never controls his/her weight; **weight control (sometimes)**: dummy variable =1 if he/she sometimes controls his/her weight **; weight control (very often)**: dummy variable =1 if he/she very often controls his/her weight**; cakes:** dummy equal to 1 if his/her parents/householders usually consume cakes; **home food:** dummy equal to 1 if he/she consumes home food at lunch time at the University.

Table 2 - Academic achievement: Probit estimates

Dependent variable: **Academic achievement**

Independent variables[a)]	MALES		FEMALES	
	Coefficients (std err.)[b)]	Marginal effects[c)]	Coefficients (std err.)[b)]	Marginal effects[c)]
Age	-0.033 (0.029)	-0.012 (0.010)	-0.040* (0.024)	-0.015*(0.009)
Ill	-0.082 (0.142)	-0.029 (0.050)	-0.187* (0.105)	-0.069*(0.039)
Tales	0.359*** (0.119)	0.127*** (0.041)	-0.025 (0.078)	-0.009 (0.029)
Mother's degree	-0.007 (0.128)	-0.002 (0.045)	-0.074 (0.125)	-0.028 (0.046)
Father's degree	-0.022 (0.130)	-0.008 (0.046)	0.225* (0.120)	0.083* (0.044)
Homework help	-0.192 (0.103)	-0.067 (0.036)	-0.124* (0.077)	-0.046* (0.029)
Liceo	0.156 (0.109)	0.055 (0.039)	0.091 (0.081)	0.034 (0.030)
Attending courses	0.304*** (0.091)	0.107*** (0.031)	0.355*** (0.071)	0.132*** (0.025)
BMI	-0.022* (0.013)	-0.007* (0.004)	-0.029** (0.012)	-0.010** (0.004)
Number of obs.	774		1183	
Wald test	32.4		50.8	
LL	-478.770		-764.028	
Overidentification test [d)]	3.746		2.101	
Wald test Exogeneity[e)]	0.21		0.55	

Legend: a) see legend in table 1; b)robust std. errors; c) average marginal effects: calculated as means of marginal effects evaluated at each observations; d) Amemiya Lee Newey test: the null hypothesis is that the instruments are valid (test statistic : χ^2 (3)); e) the null hypothesis is that the BMI variable can be treated as exogenous (test statistic: χ^2 (1)). *statistically significant at 10% level; **statistically significant at 5% level; ***statistically significant at 1% level.

Table 3. Coefficient estimates on instruments in the First-Stage Ols regression

Independent variables	MALES (std. err.)	FEMALES (std. err.)
Control weight (sometimes)	-0.678 (0.518)	-0.686** (0.309)
Control weight (very often)	-0.877*** (0.317)	0.742*** (0.199)
Cakes	0.073 (0.300)	0.216 **(0.113)
Home food	-0.016 (0.169)	-0.487 ***(0.213)
F-stat on instruments	2.29	10.1

weight control (sometimes): dummy variable =1 if he/she sometimes controls his/her weight**; weight control (very often)**: dummy variable =1 if he/she very often controls his/her weight**;** weight control (never) is the excluded dummy**; cakes:** dummy varying from 1 to 5 to 1 if his/her parents/householders usually consume cakes (1=never; 5=very often); **home food:** dummy equal to 1 if he/she consumes home food at lunch time at the University (instead of ready-made snacks); *statistically significant at 10% level; **statistically significant at 5% level; ***statistically significant at 1% level.

Table 4a - Probit estimates - Probability of enrollment in a Humanities discipline - males

Independent Variables [a)]	Coeff. (std err)[b)]	Marginal Effects[c)]	Coeff. (std err)[b)]	Marginal Effects[c)]
Mother's degree	-0.086 (0.143)	-0.022 (0.036)	-0.076 (0.141)	-0.019 (0.035)
Father's degree	-0.063 (0.148)	-0.016 (0.037)	-0.079 (0.147)	-0.020 (0.037)
Tales	0.014 (0.138)	0.003 (0.035)	0.029 (0.139)	0.007 (0.035)
Homework help	0.195* (0.112)	0.049* (0.028)	0.192 *(0.113)	0.048*(0.028)
Liceo			-0.040 (0.114)	-0.003 (0.029)
Body mass index	-0.028*(0.015)	-0.007* (0.004)	-0.029* (0.016)	-0.007* (0.004)
Illness	0.022 (0.152)	0.006 (0.038)	-0.025 (0.150)	-0.006 (0.037)
Age	0.019 (0.027)	0.004 (0.007)	0.004 (0.029)	0.001 (0.007)
Upper sec. school's score			-0.017***(0.005)	-0.005** (0.001)
Const	1.106 (0.763)		2.698 (0.936)	
Number of observations	805		805	
LL	-366.386		-360.375	
Wald test	43.93		54.97	
Overidentification test [d)]			12.201	
Wald test Exogeneity[e)]			1.74	

Legend: a) see legend in table 1; b) robust std. errors; c) average marginal effects: calculated as means of marginal effects evaluated at each observations; d) Amemiya Lee Newey test: the null hypothesis is that the instruments are valid (test statistic : χ^2 (3)); e) the null hypothesis is that the BMI variable can be treated as exogenous (test statistic: χ^2 (1)).*statistically significant at 10% level; **statistically significant at 5% level; ***statistically significant at 1% level.

Table 4b- Probit estimates - Probability of enrollment in a Humanities discipline -females

Independent Variables [a)]	Coeff. (std err)[b)]	Marginal Effects[c)]	Coeff. (std err)[b)]	Marginal Effects[c)]
Mother's degree	-0.120 (0.118)	-0.041 (0.041)	-0.025 (0.125)	-0.008 (0.039)
Father's degree	-0.392*** (0.112)	-0.135***(0.038)	-0.190* (0.116)	-0.059* (0.036)
Tales	0.153**(0.076)	0.053**(0.026)	0.159** (0.080)	0.050** (0.025)
Homework help	0.121*(0.076)	0.042*(0.026)	0.033 (0.079)	0.010 (0.025)
Liceo			-0.875*** (0.087)	-0.274***(0.024)
Body mass index	0.026**(0.012)	0.010**(0.004)	0.009 (0.013)	0.003 (0.004)
Illness	-0.146 (0.100)	-0.050 (0.034)	-0.209**(0.106)	-0.065** (0.033)
Age	-0.043*** (0.017)	-0.015*** (0.006)	-0.071*** (0.020)	-0.022***(0.006)
Upper sec. school's score			-0.024*** (0.004)	-0.007***(0.001)
Const	2.307*** (0.548)		5.402**(0.705)	
Number of observations	1287		1287	
LL	-778.598		-707.613	
Wald test	63.92		171.84	
Overidentification test [d)]			9.72	
Wald test Exogeneity[e)]			0.06	

Legend: a) see legend in table 1; b) robust std. errors; c) average marginal effects: calculated as means of marginal effects evaluated at each observations; d) Amemiya Lee Newey test: the null hypothesis is that the instruments are valid (test statistic : χ^2 (3)); e) the null hypothesis is that the BMI variable can be treated as exogenous (test statistic: χ^2 (1)).*statistically significant at 10% level; **statistically significant at 5% level; ***statistically significant at 1% level.

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