The impact of bodyweight on life satisfaction among school-aged children: Are the mechanisms gender-based?

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Abstract

Childhood obesity is not only worrisome for its effects on children's health but also for its effects on general well-being. This article analyzes the impact of bodyweight on life satisfaction and three potential mechanisms that may explain this relationship among school-aged children. In addition to the traditional ordinary least squares method, we also use an instrumental variable approach to deal with the potential endogeneity of bodyweight. We use mother's weight as plausible exogenous variation for children's weight. Using a Chilean sample of boys (n = 2,262) and girls (n = 2,256) aged 9 to 12, we provide suggestive evidence that body mass index, weight and obesity are causality and negatively related to children's life satisfaction. Our findings also suggest that body-image satisfaction, school bullying victimization, and physical health explain about 50 and 29 percent of the pathway between bodyweight and life satisfaction for girl and boys, respectively. Although, our results do not support gender differences in the bodyweight-life satisfaction association, we do find sizable gender differences in the mechanisms explaining this relationship. Finally, this study outlines some possible policy implications and potential avenues that future research should address.

I10, I12, I30
Key words: satisfaction with life, obesity, gender differences, instrumental variable, mechanisms, Chile

1 Introduction

Childhood obesity is the new global epidemic that worries society for different reasons. First, obese children are more likely to have cardiovascular problems, elevated blood pressure, dyslipidemia, and higher prevalence of factors associated with insulin resistant and type 2 diabetes (Deckelbaum & Williams, 2001). Second, there exists suggestive evidence that obesity is associated with poorer quality of mental health among children and adolescents. For example, studies in the field of psychology have shown that bodyweight is associated with mental health problems such as lower self-esteem (Strauss, 2000), depression (Sheslow et al., 1993; Sutaria et al., 2019) and suicide (Park & Jang, 2018). Third, studies in economics also provide evidence that excess of weight during childhood has long-lasting consequences in human capital accumulation through its impact on cognitive and non-cognitive skills such as academic performance (Sabia, 2007; Averett and Stifel, 2010; Scholder et al., 2012; Black et al., 2015), verbal and motor skills (Cawley & Spiess, 2008), and social and behavioral problems (Cawley & Spiess, 2008; Judge and Jahns, 2007; Sabia & Rees, 2015; Rouse & Hunziker, 2020; Palermo & Dowd, 2012; Black and Kassenboehmer, 2017), which in turn may be associated with negative outcomes in labor markets during adulthood (Cawley, 2010; Palermo & Dowd, 2012).

Although the detrimental effects of obesity on physical and mental health are important, researchers have also begun to analyze the association between bodyweight and subjective well-being (SWB) as measure of overall welfare. Results for adult samples show that being overweight or obese have detrimental effect on individuals' SWB in developed countries such as Germany, UK, and Australia (Katsaiti, 2012), US (Sato, 2021), Canada (Herman et al., 2013), Switzerland (Stutzer & Meier, 2016) and Holland (Cornelisse-Vermaat et al., 2006) and developing countries such as China (Zeng & Yu, 2019; Liu et al., 2020). The findings for children and adolescents are scant. Delgado-Floody et al. (2018) using a Chilean sample of children aged 11 to 13 found that obese and overweight children are, on average, less happy than normal-weight peers. Chang & Nayga (2010), using a nationwide survey of children between two and 12-years old in Taiwan found that children who consume more fast food and soft drink are more likely to be overweight and happier. Studies focusing on body-image perception have also found that body dissatisfaction is an important predictor of adolescents' SWB (Borges et al., 2013; Walter & Shenaar-Golan, 2017).

This study broadens the literature on obesity and subjective well-being during childhood in several ways. First, we try to disentangle the effect of bodyweight on children's life satisfaction using an instrumental variables (IV) approach. So far, the literature on the relationship between obesity and subjective well-being has mainly used methods without a strong identification strategy, such as ordinary least squared (OLS), structural equation model (SEM), and non-linear models (Probit and Logit). However, if unobserved factors affecting children's life satisfaction are also correlated with their bodyweight, then the estimates will be biased. The IV approach requires an instrumental variable that is correlated with the explanatory variable, but uncorrelated with the outcome variable. We used five-years lagged mother's bodyweight as a plausible exogenous instrument for children's weight. Although, this instrument has been used in previous studies analyzing the effect of bodyweight in adolescents' mental health (Sabia & Rees, 2015), and children's and adolescents' cognitive and non-cognitive development (Averett & Stifel, 2010; Scholder et al., 2012; Black et al., 2015), to our knowledge we are the first using it to disentangle the effect of bodyweight on life satisfaction among children.

Second, we assess whether the association between excess weight and life satisfaction among children can be explained by three potential mechanisms suggested in the literature: (1) bullying, (2) health, and (3) body-image satisfaction (Russell-Mayhew et al., 2012). Some studies suggest that obese children show poorer mental health because they experience bullying victimization. Accordingly, the psychological consequences of obesity may be attributable to weight stigmatization and discrimination, which are mainly expressed through teasing and bullying among children and adolescents (Puhl & Latner, 2007).

Other studies suggest that bodyweight has an impact on psychological well-being because it deteriorates children's health (Heo et al., 2003). As previously mentioned, obese children are associated with several health problems, which in turn negatively affects children's mental health (Deckelbaum &Williams, 2001). Similarity, Böckerman et al. (2014) show that the association between obesity and subjective well-being is mostly mediated by health and functional capacity for individuals aged 30 and over.

Other researchers suggest that bodyweight perception and body-image dissatisfaction may explain the relationship between current bodyweight and psychological well-being (Erickson et al., 2000; Friedman et al., 2002; Allen et al., 2006). According to Friedman et al. (2002), body image is an important mediator in western societies where there exist pressures to be thin among girls and muscular among boys. Thus, it is expected that body shape and image ideals may also explain gender differences in the relationship between current bodyweight and life-satisfaction. Given the increasing prevalence of overweight in children and adolescents, other studies suggest that feeling fat may be more important than being fat in terms of psychological well-being (Jansen et al., 2008).[1]

Finally, this study focuses on a developing country with high rates of adult and childhood obesity. According to the latest National Health Survey (ENS, 2017) 39.8 percent of the population is overweight, 31.2 percent is obese, and 3.2 percent has morbid obesity, placing Chile in the second position in the ranking that considers countries belonging to the Organization for Economic Co-operation and Development (OECD). Among children these figures are even more worrisome because the last report of JUNAEB (2020) revealed that 52 percent of Chilean schoolchildren are overweight or obese.

Our main findings confirm the existence of a negative causal association between bodyweight and life satisfaction for both girls and boys. This effect is robust to the use of different measures of bodyweight such as weight (in kilograms), standardized body mass index and obesity. Importantly, when exploring the potential mechanisms behind this result, substantial differences emerge between girls and boys. Consistent with previous literature (Jones, 2004; Choukas-Bradley et al., 2020), girls are particularly concerned with their body-image and consequently it plays a significant role as a mediator between their bodyweight and life satisfaction. This provides evidence that Chilean girls experiment the negative consequences associated to an excessive concern about their body-image in the same way as in other western countries, such as the United States and United Kingdom (Perloff, 2014 and the references therein). For boys, although body-image satisfaction is also a relevant mechanism behind the negative effect of bodyweight and life satisfaction, it plays a minor role compared to girls. Finally, it is found that, for both girls and

[1] Jansen et al. (2008) argue that one explanation for the fact that an association between bodyweight and mental well-being is not always found may lie in the mediating effect of bodyweight perception. Accordingly, children and adolescent tend to have a body ideal based on their peers. Since a higher proportion of children and adolescents are now overweight, being overweight may have become normal, and feeling of being too fat and the accompanying detrimental effect on mental well-being at present may have been shifted to higher bodyweight than before.

boys, the relationship between bodyweight and life satisfaction is also significantly mediated by bullying victimization but to a lesser extent than body-image satisfaction.

2 Methods

Our methodological approach starts by estimating the following specification by ordinary least squares (OLS) for boys and girls, separately:

$$LS_i = \beta W_i + \boldsymbol{x}_i' \boldsymbol{\lambda} + \epsilon_i, \quad (1)$$

where the dependent variable, LS_i, is our measure of life satisfaction (LS) for child i; W_i is some of our bodyweight measures; $\boldsymbol{x}_i$ is the vector of exogenous controls which contains some basic characteristics for children, mothers, and household; and ϵ_i is the error term. Our hypothesis based on previous empirical evidence is that there exists a negative total impact of bodyweight on children's LS, $\beta < 0$.

At best, β OLS estimates only the total effect of bodyweight on LS and does not tell us why heavier children might have poorer LS. Thus, we then ask: how much of the total negative effect of bodyweight on LS can be explained by some mechanisms suggested in the literature? As previously mentioned, we focus in three potential pathways through which bodyweight may affect LS: body-image (BI) satisfaction, bullying victimization at school, and the presence of comorbidities as a measure health complication.

Following Böckerman et al. (2014), we then proceed to estimate OLS models adding our mediator variables as follows:

$$LS_i = \beta W_i + \delta M_i + \boldsymbol{x}_i' \boldsymbol{\lambda} + \epsilon_i, \quad (2)$$

where M is some of our mediators. By including the mediator variables, we are blocking the potential pathway of W to LS through M. Thus, if the OLS-point estimate for bodyweight remains statistically significant, then there exists evidence that bodyweight affects indirectly LS not only through our mediator variables, but also by other potential channels of influence not considered in this work. On the other hand, if the estimate is not significant, it suggests that the total detrimental effect of W on LS among children is driven by the indirect effect of bodyweight through our mediator variables. It is important to bear in mind that this approach does not allows us to compute the effect of M on LS, since M might be endogenous. Thus, we report the percent decline in the coefficient of bodyweight from adding each mediator as a measure of the role of these pathways in the W-LS association.

Just as the coefficient of M on LS is not identified, the OLS estimator for W also does not deliver the true causal effect if children's weight is endogenous. For example, there might exist unobserved factors (such as child's motivation, unobserved parents' preferences for investing in their child, etc.) relegated to the error term and positively (negatively) correlated with children's bodyweight resulting in an underestimation (overestimation) of the true bodyweight effect. Similarly, the literature has suggested that reverse causality is a serious issue when estimating the association between obesity and SWB. For example, less happy children may generate eating disorders resulting in bodyweight changes (Black et al., 2015). In any case, the estimate for bodyweight will be biased and the share explained by the mediator variables may be under or overestimated.

To deal with the endogeneity of children's weight, we use an IV approach. In this case, the model becomes:

$$LS_i = \beta W_i + \boldsymbol{x}_i'\boldsymbol{\lambda} + \epsilon_i, \tag{3}$$
$$W_i = \pi Z_i + \boldsymbol{x}_i'\boldsymbol{\gamma} + v_i, \tag{4}$$

where Z is the instrument for children's bodyweight, π is the causal effect of the instrument on W, Equation (3) is the structural-form equation, and Equation (4) is the first-stage equation. In this study, we use 5-years lagged mother's BMI as plausible exogenous variation for current child's weight.

Lagged mother's BMI must comply with some assumptions to be a valid instrument. First, it must be relevant. That is, it must be partially and highly correlated with child's weight once the other exogenous variables have been netted out ($\pi \neq 0$), otherwise the IV estimator will be biased resulting in a weak-instruments problem. This assumption is supported by empirical studies showing that roughly half of the variation in weight is genetic in origin (Comuzzie & Allison, 1998), thus mother's weight should be a strong predictor of children's weight through shared genes (Cawley, 2000).

A second assumption is that the instrument is not correlated with the error term. That is, mother's weight must be independent of unobserved factors affecting child's LS. Two factors may jeopardize this assumption. First, our instrument must satisfy the exclusion restriction, i.e., mother's weight must affect child's LS only through its impact on child's weight. If, on the other hand, mother's weight exerts both direct and indirect influences on child's LS, the exclusion restriction should be rejected, and hence the IV estimates will be biased.

Second, and even assuming that the exclusion restriction is met, mother's weight could be potentially correlated with omitted variables affecting child's LS (also known independence assumption). For instance, shared genetic factors related to excess of weight may also be related to factors affecting children's mental health (Willage, 2018). To prevent bias from shared genetic disposition, we control for current mother depression and whether the mother had post-partum depression to increase precision. Similarly, unobserved family factors common to mothers and children might also affect parental and child weight. For example, mother's weight is likely to be correlated with habits, lifestyles, or food preferences in the household which in turns affect child's LS (Lindeboom et al., 2010). To mitigate this concern, and following Lindeboom et al. (2010), we control for mother's risky behaviors during pregnancy (smoking, drug used, drinking alcohol) and the number of months of breastfeeding. According to Lindeboom et al. (2010), these variables are likely to be good proxies for parents' preferences to invest in their child. To hold eating habits at home constant to some extent, we also control for the number of meals that children share with someone in their family.

It should bear in mind that under monotonicity assumption (that is, the instrument affects children's weight in the same direction for all children), the IV estimates apply only to those children whose weight would have changed if their genetically predisposed (Greve, 2016). This effect is known as the Local Average Treatment Effect (LATE) and applies to those individuals whose are responsive to our instrument (compliers) and thus it is not generalizable to always taker (those children who are heavier regardless of whether they are genetically predisposed to be obese) and never takers (those children who are not heavier even though they are genetically predisposed to be obese).

The mechanism-testing method is similar to that used in the OLS context. That is, we run the IV estimator without the mediating variables and then we add the mediator variables and calculate the percent decline in the LATE coefficient of bodyweight.

3 Data

The data used in this work comes from the third wave (2017) of the Chilean Longitudinal Study of Early Childhood (ELPI, 2017), which is a representative survey of children in Chile and carried out by the Ministry of Social Development and Family. Its objective is to characterize and analyze the development of successive cohorts of boys and girls throughout their childhood, considering home characteristics, access to health, education and housing services, and parents' information.

Although the ELPI was also carried out in 2010 and 2012, this study includes children aged 9-12 years who responded the life-satisfaction question applied only in the 2017 wave. The sample used in this work consists of boys (n = 2,262) and girls (n = 2,256) who have non-missing values on the main outcome (LS), covariates and weight/height measures.

The information was collected in two steps. In the first home visit, the interviewer collected information about child's development, socioeconomic and demographic characteristics, home environment, and parents' behaviors by face-to-face interview to the child's main caregiver at home. In the second visit, several instruments were applied to both the main caregiver and the selected child to evaluate socioemotional development, cognitive aspects, and anthropometric measurements (weight and height). Since we use mother's weight as exogenous variation, we also kept those children whose biological mother is the main caregiver and therefore was part of the second interview.

3.1 Dependent variable

The dependent variable comes from the following question to children: "To what extent are you satisfied with your life as a whole?" This question uses a 1-7 scale, anchored from "not satisfied at all" to "very satisfied". This variable is a multidimensional construct and is intended to measure how individuals evaluate their own lives, both in general and for specific life domains (Diener et al., 1999). Some studies have also found that LS correlates better with objective measures of well-being, such as suicide and frequency of smiling, than other SWB measures (Perez-Truglia, 2015).

Table 1, which reports summary statistics by gender, shows that the average LS across girls and boys is approximately 6.5 with low standard deviation revealing that the distribution is mostly skewed to the right. The relative frequencies are displayed in Figure 1. Almost 70 percent of boys and girls consider themselves to be very satisfied with their lives, whereas girls are slightly unsatisfied than boys.

(Insert Table 1 about here)

(Insert Figure 1 about here)

3.2 Bodyweight measures

We use three variables widely used in the empirical literature as bodyweight measures for children: (1) the weight in kilogram (controlling for height), (2) the body mass index (BMI) age-sex specific z-score, and (3) a dummy variable indicating whether the child is obese (> 95th percentile in the age and gender specific BMI distribution). It is important to mention that both weight and height were measured by a trained interviewer, which reduces the possibility of measurement error bias in our estimations. To disentangle the effect of children's bodyweight on LS, we use the mothers' BMI in the previous round (2012) of the survey as an IV. Both the mothers' weight and height were also measured by trained interviewer in 2012 at the second visit.

These variables are summarized in Table 1. It can be observed that 5 percent of boys and girls are obese. Likewise, the average BMI is similar for both genders; approximately 21. Among mother in our sample, the average BMI in the previous round of the survey was approximately equal to 28.

3.3 Controls and mediators

In all our specifications, we control for child, household, and maternal characteristics. We also include regional dummy variables to control for spatial differences. Children's controls include age (in month) and its square, and the number of older and younger siblings. The characteristic of the household includes a dummy variable indicating whether the child lives with the biological father in the same household, the natural logarithm of monthly household income, household size, and the number of meals that the child shares with some family member. This last variable ranges from 0 (zero meal) to 3 (breakfast, lunch, and dinner). Mother's characteristics include their marital status, schooling (in years), age and age squared (in years), a dummy variable indicating whether they have depression (using the Center for Epidemiological Studies Depression-CESD 10) in 2017, another dummy variable indicating if the mother was diagnosed with post-partum depression, a dummy variable equal to one if they are the head of the households, variables indicating if the mother smoked, used drugs, or drank during pregnancy, and the number of month that the mother breastfeed the child.

In our analysis of the potential mediators, we use three variables. First, we use the Social and School Climate Scale Test (ECLIS in Spanish) as measure of school bullying victimization. This test was designed as a tool to obtain a profile of the school social climate from the perspective of the students. It consists of five subscales, but only the bullying subscale was applied in the 2017 wave to boys and girls aged 7 to 12. The questionnaire consists of eight items that have response categories on a Likert scale related to periodicity (never, rarely, almost always, and always) with values from 1 to 4, respectively. The total score is obtained as the simple sum of the points assigned to each question. Thus, a higher score indicates a negative perception of school climate. The questions are presented in Appendix A.

To test the obesity-health channel we use a dummy variable indicating whether the child has some obesity-related comorbidities such as sleep apnea, high blood pressure, elevated insulin levels, or type 2 diabetes mellitus.

Finally, we evaluate the role of body-image (BI) satisfaction by using some questions of the School Self-esteem Test (TAE in Spanish). The TAE test was applied to boys and girls aged 7 to 12 in the 2017 wave of ELPI. The questionnaire is made up of 23 statements whose response categories are "yes" and "no". One point is awarded for each response that is positive from a self-esteem perspective and zero points for each response that indicates low self-esteem. For BI satisfaction, we compute the raw score by performing a simple sum of the points assigned to each of the following questions: (1) "My appearance bothers me, how I look", (2) "I am good-looking", and (3) "I have a nice face". In this way, the total score could reach a maximum of 3 points. The closer to the upper limit, the better the child's BI satisfaction. All these controls and mediators are listed in Table 1.

4 Results

4.1 Is bodyweight associated with the mediator variables?

We start our analysis by looking at the associations between bodyweight and our mediator variables among children. Table 2 displays the OLS estimates for girls, boys, and both. For the sake of brevity, the main tables in this work present only the coefficients associated with the weight variables. All our estimates report clustered standard errors at the spatial-unit level to account for the ELPI research design.

(Insert Table 2 about here)

Columns 1-3 show that all our measures of bodyweight are statistically associated with the three mediator variables among children. The results using z-BMI (Panel A) show that an increase of one SD of BMI: (1) decreases body-image satisfaction (BIS) score in about 0.11 points (on a scale of 0-3), (2) increases bullying victimization at school in 0.156 points (on a 32-unit scale), and (3) increases the probability of having some comorbidity associated with excess of fat in about 0.024 percent. These results are mainly driven by girls; columns 4-9 show that the association between z-BMI and the mediator variables is always higher for girls than boys. In fact, z-BMI is not statistically associated with bullying victimization among boys. This gender differential can be explained by the fact that boys are more often victims of bullying if they are physically weaker. Thus, for boys being heavier may be rather an advantage than a deficit (Griffiths et al., 2006). Another potential explanation may be the inability of BMI to discriminate how much muscle versus fat individuals have (Burkhauser & Cawley, 2008). Consequently, moderate high BMI among boys might be reflecting higher average lean mass rather than higher fatness.

Panel B shows the results for obesity. Our findings show that being in the right tail of the age-gender specific BMI distribution is detrimental for children's BI satisfaction and increases the chances of being bullied at school. The relationship between being obese and bullied among boys is now slightly significant and negative. This could indicate that, although being heavier could be beneficial to avoid being a victim of bullying, a high excess of weight does increase the probability of being victim of bullying by classmates. There exist also some gender differences in terms of bad health. Obese girls are four percent more likely to have obesity-related comorbidities than non-obese girls, however we do not find sufficient statistical evidence to reject the null of zero relationship between obesity and health problems among boys.

Last panel of Table 2 displays the results for weight in kilograms controlling also for height in centimeters. The results are similar to the previous ones; an additional kilogram is associated with our three mediator variables, but the magnitudes are slightly higher for girls than boys.

Summing up, children's bodyweight is associated with potential mechanisms that can explain its effect on LS. In terms of gender differences, the associations appear to be stronger for girls. For boys, we found that all measures of bodyweight are strongly associated with BI satisfaction, however the results for bullying and bad health are mixed.

4.2 Bodyweight, life satisfaction and mediators: OLS results

In this section, we first assess if there exists evidence of a negative association between LS and bodyweight. Then, we ask whether this association is mediated by BI perception, bullying victimization and/or bad health.

Table 3 shows the OLS results for girls and boys. We start by looking at the results for girls (left panel). Column 1 of panel A supports previous findings in the literature and indicates that increases in z-BMI are associated with decreasing LS ($p < 0.01$); having one SD more of BMI is associated with scoring 0.155 points lower (on a scale of 1-7) on LS. To put this result in context, among girls an additional SD of BMI is associated, on average, with a reduction in LS similar to a decrease of 38 percent in monthly household income and half of the magnitude if the father does not live with the child.

(Insert Table 3 about here)

A difference between more heavy children and less heavy children is their own perception of body size and shape. More heavy children are in general less satisfied with their own body, which in turn may affect LS. Column 2 of panel A shows that by controlling for BI satisfaction the OLS-point estimate for z-BMI in the LS equation falls by 44 percent. As expected, BI satisfaction is positively associated with LS among girls; a one-point increased in BI satisfaction is associated with an increase of LS in 0.35 points ($p < 0.01$), on average. Despite the decrease of the association, the estimate for z-BMI is still significant ($p < 0.05$) suggesting that there exist other potential channels of influence. Column 3 tests whether school bullying victimization is another pathway between bodyweight and LS. The reduction in the z-BMI coefficient is 14 percent which is lower than that in column 2 and remains statistically significant ($p < 0.01$). The estimated coefficient for bullying implies that an additional unit of bullying-victimization score decreases life satisfaction in 0.052 points.[2] The fourth column shows that controlling for bad health does not affect the z-BMI coefficient that much. Finally, the fifth column indicates that our three mediator variables account for 48 percent of the association between z-BMI and LS among girls.

Panel B shows the results for obesity. In column 1, we find that obese girls score 0.35 points lower in LS than non-obese girls ($p < 0.01$). Close to the results using z-BMI, the OLS coefficient for obesity is reduced when adding our mediator variables. However, the reduction is lower when adding the three variables jointly: BI satisfaction, bullying at school and bad health account for 35 percent of the estimated difference in LS between obese and non-obese girls.

The last panel uses weight in kilograms as measure of bodyweight (controlling also for height). The results are in line to those using z-BMI. BI satisfaction is the mechanisms that most accounts for the reduction in the weight coefficient. On the other hand, bad health is not statistically associated with LS. The three mechanisms account about 56 percent of the reduction of weight coefficient.

The results for boys reveal an interesting pattern (right panel, columns 6-10). Neither z-BMI nor obesity are statistically associated with LS. Although the weight coefficient is statistically significant (column 6), column 10 points out that the total adverse effect is driven by our three mediator variables. Additionally, body height matters for LS only among boys even after accounting for BI satisfaction and bullying score. Given the construction of our weight variables, these findings could suggest that bodyweight matters when boys compare themselves to other boys of other ages.

Some studies have documented a U-shape relationship between obesity and SWB (Austin et al., 2009). We explore this in Figure 2 which plots the estimated association between z-BMI and LS for boys and girls using a quadratic specification. We observe an inverted U pattern for both groups; lower levels of z-BMI are positively associated with LS, whereas higher levels (z-BMI > -0.5) are associated with increasing negative partial changes in LS. While the association is only significant at the 5 percent for girls when z-BMI > -0.5, for boys we do not find suggestive evidence at any level of BMI.

[2] As noted by one of the reviewers, our measure of bullying victimization does not tell us whether children are bullied because they are heavier. Thus, this variable may not be fully capturing the pathway from obesity to LS, and hence caution is suggested. However, as shown in Table 2, it is highly correlated with bodyweight, especially among girls.

(Insert Figure 2 about here)

So far, our results show that bodyweight is negatively associated with LS only among girls. The most important mediator is BI satisfaction, followed by school bullying victimization and with bad health playing only a modest role. Depending on the bodyweight measure used, our three variables account for 35-56 percent of the bodyweight coefficient among girls.

4.3 Bodyweight, life satisfaction and mediators: IV results

Since the previous estimates cannot be interpreted as causal due to endogeneity issues, in this section we provide further evidence of the role of the mediator variables using mother's BMI in 2012 (5-years lagged) as exogenous variation for child's bodyweight.

To give some preliminary insights of the potential bias, we use Kinky Least Squares (KLS) estimation (Kiviet, 2020) which analytically correct the bias of the OLS coefficient for all values of the correlation between the error term and children's bodyweight. For the sake of brevity, Figure 3 shows the KLS estimates of the effect z-BMI and obesity for girls and boys assuming that the degree of endogeneity is in the interval $\rho_{w,\epsilon} \in (-0.7, 0.7)$.[3] Under $\rho_{w,\epsilon} = 0$, the OLS estimates are the true effect of bodyweight on LS. However, it can be observed that the corrected OLS coefficient for each measure of bodyweight is positive (negative) if the true correlation between the error term and children's weight is less (higher) than -0.1. In other words, the sign of the coefficients is very sensitive to the sign of the covariance between the error term and weight. Furthermore, the magnitude of the estimates is also very sensitive to the magnitude of the degree of endogeneity.

Although it is difficult to give a preliminary idea if the degree of endogeneity is positive or negative, previous research focusing on children and using an IV and/or fixed effects approach to analyze the effect of weight on cognitive, socio-emotional, and mental development have found that such estimates are more negative than the OLS estimates (Scholder et al., 2012). That is, it is highly likely that there is a positive correlation between children's weight and the error term.

(Insert Figure 3 about here)

[3] The results for weight are presented in Figure B.1 Appendix B.

4.3.1 Validity of the instrument

One key assumption is that our instrument is highly correlated with bodyweight. Figure 4 shows a strong positive association between lagged mother's BMI and all our measures of children's bodyweight for both girls and boys. Additionally, Table 6 presents first-stage F-statistic from the IV models for both groups. All F-statistics are substantially above the traditional cut-off of ten. Thus, a potential weak-instrument problem is precluded. Although monotonicity cannot be tested, we provide some evidence in Figure 4. The relationship is positive and increasing for all our measures of children's bodyweight; an increase in lagged mother's BMI is associated with higher BMI, z-BMI, the probability of being obese and weight in kilograms for both girls and boys.

(Insert Figure 4 about here)

A second assumption is that the instrument is not correlated with the error term. We provide some evidence about the exclusion-restriction bias in Table 4 by presenting the association between mothers' lagged BMI and current children's LS. We observe that the correlations are not statistically different from zero among girls whereas for boys, the association is only significant at 10 percent and the magnitudes are rather small. Thus, even if there exists a direct effect, the potential bias due to the exclusion restriction is unlikely to explain our results.

(Insert Table 4 about here)

To assess the relationship between mothers' BMI and other characteristics, we compare children with obese and non-obese mother. Obese mothers are those whose BMI in 2012 was greater or equal to 30. Table 5 contains the mean of the mothers' and children' characteristics for children with obese and non-obese mothers. We observe significant differences among mothers' characteristics. For example, obese mothers in 2012 have on average one year less of education in 2017 than non-obese mother for both girls and boys. In addition, obese mothers are on average older and have more older children than non-obese mothers. The results also confirm that obese mothers are more likely to be depressed providing evidence that genes related to weight are potentially also associated with mental health. By contrast, we do not observe significant differences between obese and non-obese mothers in household characteristics such as household income and household size. Although it is not possible to prove that null hypothesis of no effect of household environment on mother's and child' bodyweight, previous studies provide suggestive evidence that experiences shared among family members are irrelevant in determining individuals' differences in weight (Grilo & Pogue-Geile, 1991).

(Insert Table 5 about here)

4.3.2 Estimates

Columns 1 and 6 of Table 6 show the IV estimates without controlling for any mediator variable for girls and boys, respectively. In general, the IV-point estimates are more negative than those OLS estimates from Table 3. In addition, the coefficients for z-BMI and obesity among boys are now significant, however the estimates for girls lose some precision, especially the IV coefficient for weight. The results for z-BMI reveal that a one-SD increase in BMI would reduce LS by approximately 0.29 points for both girls and boys ($p < 0.05$). This impact is about two and ten times more negative than the OLS estimates for girls and boys, respectively. According to column 1 of Panel B, obese girls score one point lower in LS than non-obese girls ($p < 0.05$), whereas column 6 shows that obese boys score 1.4 lower ($p < 0.01$) than non-obese peers. The closer results between girls and boys, compared with our previous OLS findings, may suggest that gender-differences are due to endogeneity issues. To further test the gender differences, we also run pooled IV models with gender interactions. As instrument for the endogenous interaction, we use the interaction between lagged mother's BMI and children's gender. The results in Table B.2 (in Appendix B) shows there is not sufficient evidence of differential effects of bodyweight on LS by gender.

(Insert Table 6 about here)

It is important to highlight that there are different non-exclusive reasons that can explain the fact that the IV-point estimates are more negative than the OLS-point estimates. For example, it may suggest that bodyweight is positively correlated with the error term, being this correlation stronger for boys. According to KLS estimates in Figure 3 and our IV estimates, a conservative conclusion is the potential correlation between children's bodyweight and the error term is at least 0.05-0.15 for girls and 0.18-0.25 for boys. A positive correlation between bodyweight and the error term may arise because of an omitted variable that is positively (negatively) correlated with both children's life satisfaction and bodyweight. This result is also consistent with a reverse causality problem in which higher child's life satisfaction reduces weight. However, differences could also be explained by the fact that OLS correlations are average treatment effects (ATE), and IV estimates are LATE based on variation in bodyweight due to genetic predisposition. Thus, if mother's weight raises child's bodyweight who would otherwise have lower bodyweight, and these children have higher marginal impact of bodyweight on LS, then the IV estimator would be larger than the OLS estimator. It may be also possible that our instrument is negatively correlated with the error term resulting in an overestimation of the true negative effect of bodyweight.

Although the IV estimates are negative and statistically significant among girls, eyeballing the results in Table 6, we can observe that controlling for BI satisfaction the negative impact of bodyweight on LS disappears completely. This mechanism explains about 34 percent of the effect of z-BMI and obesity, and about 35 percent of effect of weight when using our IV procedure. In terms of the importance of the mechanisms, BI satisfaction it is followed by bullying and bad health. In total, these three mechanisms explain again 48 percent of the total impact of bodyweight on LS among girls, but unlike our previous OLS results, the bodyweight effects are no longer significant. That is, the associations between the mediator variables and LS are mostly unaffected and very close in magnitude to those found using OLS.

Among boys, the amount explained by BI satisfaction is about 24 percent, which is lower than among girls. In addition, the bodyweight coefficients are insensitive to the inclusion of bad-health control and the three mediator variables explain about 28 percent of the reduction of bodyweight coefficient. One potential explanation for the small reduction in coefficients is that weight has little direct impact on the mechanisms among boys as shown in Table 2, especially on bullying and bad health. Thus, it is very unlikely that these variables mediate the bodyweight-LS association among boys.

In sum, all our bodyweight variables are negatively associated with LS. The magnitudes of the IV estimates are large and comparable with a decrement in LS more than 40 times larger than a decrease of 50% in monthly household income. We also find that increased BMI is continuously associated with poorer SWB which indicates that not only children with extreme excess of weight were at risk.[4] However, the pathways through which they affect children's LS is gender-based. Considering the average reduction in bodyweight coefficient, BI satisfaction, bullying victimization at school, and bad health explain 50 and 29 percent of the pathway between bodyweight and LS for girls and boys, respectively.[5]

4 Discussion

Our results show that body mass index, weight and obesity are causality and negatively to children's LS during middle childhood. If we consider that LS is highly associated with mental health, then these findings are consistent with psychological theories suggesting that young children's mental health is causally related to bodyweight (Strauss, 2000; Griffiths et al., 2006). Our results also support previous studies that have found a negative relationship between bodyweight and mental health problems in Chilean children and adolescents (see for example, Delgado-Floody et al., 2018; Delgado-Floody et al., 2021).

This main result is important considering that Chile is a country with high rates of childhood obesity and a high degree of weight discrimination. The Chilean government has implemented different policies to reduce and prevent childhood obesity. These include compulsory front-of-package warning sign for packaged foods that exceed the established cutoffs, high regulation of food industry advertising (especially advertising aimed at children under 14 years of age), and total ban on sales in schools of all packaged foods exceeding critical cutoffs. Our findings suggest that early treatment interventions for childhood obesity not only might generate positive impacts on children's health, but also might generate positive externalities by improving children's overall subjective well-being. However, it is also prudent to consider more integrated physical and behavioral programs to boost the benefits on children's health.

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[4] It is worth emphasizing that mothers' weight raises the bodyweight of children who would otherwise have lower bodyweight. If these children have higher marginal impact of bodyweight on self-esteem, then the IV estimator may overestimate the average marginal effect of bodyweight in the population. Therefore, caution is suggested when extrapolating our estimates.

[5] As suggested by an anonymous reviewer, our results may be driven by non-linearities in the relationship between LS and bodyweight. To address this concern, we have also estimated an IV model using as an additional variable the squared of z-BMI. As instrument for this additional endogenous variable, we used the mother' lagged BMI squared. The results (available upon request) show that, although the IV estimates are estimated with less precision, the magnitudes are rather constant across different values of z-BMI. Thus, we found little evidence that the relationship, at least in our sample, is non-linear.

Our findings also emphasized the importance of controlling for the potential endogeneity of bodyweight. Failure to use methodologies with strong identification strategies may result in an underestimation of the true detrimental effect on children's SWB. Specifically, our results showed that the IV estimates were approximately two and ten times more negative than the OLS estimates for girls and boys, respectively. This suggests that, at least in our sample, both omitted variables and reverse-causality may contaminate OLS estimates resulting in an underestimation of the true detrimental effect of bodyweight in children's LS. A similar magnitude of the underestimation of the weight penalty is also found by similar studies using an IV approach but analyzing different children's outcomes (Averett & Stifel, 2010; Scholder et al., 2012; Black et al., 2015; Sabia, 2007; Sabia & Rees, 2015).

Unlike most previous studies (e.g., Sabia & Ress, 2015), we do not find evidence of gender differences in the weight penalty once endogeneity issues have been considered. Similar conclusion is reached by Black & Kassenboehmer (2017); they found that the effect of obesity on children's emotional problems are similar by gender, although slightly stronger for girls.

The IV estimates should be considered, at most, as the total LATE of bodyweight on children's LS. Thus, determining the pathways through which bodyweight reduces life satisfaction can be useful for prevention and intervention for mental health problems among children with increased BMI (Stunkard et al., 2003; Russell-Mayhew et al., 2012). We assess how much of the total effect of BMI and obesity can be explained by some suggested mechanisms in the literature: body-image satisfaction, school bullying victimization, and health.

We find that body-image satisfaction is the most important mediator of the bodyweight-LS relationship among children; it explains on average 34 percent of the total LATE effect of bodyweight among girls, and about 24 percent among boys. Our results also suggest that this mechanism is the most important for girls; by adding BI satisfaction, the coefficients for all our measures of bodyweight becomes statistically insignificant. This finding is in line with previous research suggesting that while both genders are exposed to culturally imposed body shape and size ideas, girls experience greater social pressure to conform beauty and appearance standards (Griffiths et al., 2006; Austin et al., 2009). It is also consistent with gender differences in westernized societies like the Chilean society where thinness is the culturally ideal for females, while males are encouraged to be both lean and muscular (Russell-Mayhew et al., 2012). Our results are also close to those reporting that weight perception or body dissatisfaction mediates the effect of obesity and: (1) happiness (Mond et al., 2011; Erickson et al., 2000), (2) depressive symptoms (Erickson et al., 2000), (3) mental health indicators (Jansen et al., 2008), and (4) self-esteem (Allen et al., 2006; Shin & Shin, 2008).

The role of bullying victimization as mediator is also important, but less salient than BI satisfaction; it explains on average 22 and 12 percent of the reduction of the total LATE effect of bodyweight for girls and boys, respectively. These results agree with those found by Yen et al. (2014). Using a SEM approach, they showed that victimization of passive and active bullying had a mediating effect on the relationship between BMI and four mental health problems among adolescents in Taiwan. Using a young sample under 35 years old, Willage (2018) also shows that social stigma is a possible mechanism by which high BMI affects mental health for white women.

Unlike Böckerman et al. (2014), our findings suggest that health complications explain very little the link between child' bodyweight and LS. A potential explanation for this finding is that BMI does not distinguish fat from muscle, bone, and other lean body mass and hence it is less accurate to reflect the true adiposity of children which is more correlated with obesity comorbidities.

Overall, this study confirms the existence of a gender-based mechanisms through which children's bodyweight affects LS. The critical importance of body-image among girls places this research within a broader social concern that stresses how pervasive gender issues still are in modern societies that can also harm the quality of life of girls during their middle childhood. A major conclusion that one can draw from the literature that have addressed the detrimental effects derived from an excessive concern of body-image among women—a social problem exacerbated over the last years due to the increasing penetration of social media such as Instagram— is how feminist beliefs can act as a first defense barrier against the social pressure associated with the internalization of the thin-ideal body image of women (Feltman & Szymansky, 2018; Myers et al., 2012).

Following this reasoning, it can be argued that although both victimization of bullying and body-image dissatisfaction should be the target of prevention and intervention programs, it may well be equally valuable to foster among children, and especially girls, ideas and conceptions that reject cultural standards of beauty and the excessive concern on physical appearance and place more value on women's skills and abilities and how they can interact and contribute to the development of society (Feltman & Szymansky, 2018). In this scenario, the efforts made towards reaching a more egalitarian society where women—among other gender discriminatory practices—do not have to face additional pressures derived from cultural standards of beauty, should not only be focused on reducing inequalities between adult men and women in terms of labor market conditions, housework and childcare, but also promoting feminist values among children to reduce gender-based inequalities that affect girls even at early stage of their childhood.

Finally, we conclude that the three mechanisms explain almost 50 and 29 percent of the pathway between bodyweight and LS for girls and boys, respectively. This suggests that there might exists other mechanisms explaining the relationship for boys and hence further research is needed.

6 Conclusion

This study focused on the effect of bodyweight on school-aged children's LS. Using a sample of 4,518 Chilean children aged nine to 12 and an IV approach, we found strong evidence that higher bodyweight reduces children's LS. In addition, our findings suggested that the detrimental effect is mostly mediated by school bullying victimization and BI dissatisfaction. Although these results are difficult to generalize to the overall population of children, the main findings have interesting consequences for the subpopulation composed by children who are genetically predisposed to lose or gain weight.

This study is not without limitations. First, the cross-sectional research design of this study limited our ability to draw conclusions about the dynamic association between BMI, obesity, and life satisfaction. Second, although we used anthropometric measures of weight and height for both children and mother, the use of BMI has been criticized as measure of excess of fat. For example, BMI does not distinguish fat from muscle, bone and other lean body mass and hence it is less accurate to reflect the true adiposity of individuals (Burkhauser & Cawley, 2008). Similarly, some studies showed that BMI performed poorly to predict cardiovascular diseases compared with other abdominal obesity index such as the waist-to- height ratio (Lee et al., 2008). This result may also explain why we were not able to find a pathway between obesity and health diseases. Another issue is the location or distribution of the fat. Two similar children with similar BMI, but one with the fat concentrated around the waist may have a more elevated risk of morbidity and experience lower self-perceived body-image than one with fat that is more evenly distributed around the body. Future work is needed to analyze the effect of bodyweight on SWB using more accurate measures of fatness. Finally, our dependent variable is just one of the many measures of subjective well-being that have been used in the literature. It is important in the future to analyze whether our results are robust to other measures such as happiness or more objective variables of mental health.

References

Allen, K. L., Byrne, S. M., Blair, E. M., and Davis, E. A. (2006).Why do some overweigh children experience psychological problems? the role of weight and shape concern. International Journal of Pediatric Obesity, 1(4):239–247.

Austin, S. B., Haines, J., and Veugelers, P. J. (2009). Body satisfaction and body weight: gender differences and sociodemographic determinants. BMC public health, 9(1):1–7.

Averett, S. L. and Stifel, D. C. (2010). Race and gender differences in the cognitive effects of childhood overweight. Applied Economics Letters, 17(17):1673–1679.

Black, N., Johnston, D. W., and Peeters, A. (2015). Childhood obesity and cognitive achievement. Health economics, 24(9):1082–1100.

Black, N. and Kassenboehmer, S. C. (2017). Getting weighed down: the effect of childhood obesity on the development of socioemotional skills. Journal of Human Capital, 11(2):263–295.

Böckerman, P., Johansson, E., Saarni, S. I., and Saarni, S. E. (2014). The negative association of obesity with subjective well-being: is it all about health? Journal of Happiness Studies, 15(4):857–867.

Borges, A., de Matos, M. G., and Diniz, J. A. (2013). Body image and subjective well-being in portuguese adolescents. The Spanish journal of psychology, 16.

Burkhauser, R. V. and Cawley, J. (2008). Beyond bmi: the value of more accurate measures of fatness and obesity in social science research. Journal of health economics, 27(2):519–529.

Cawley, J. (2000). An instrumental variables approach to measuring the effect of body weight on employment disability. Health Services Research, 35(5 Pt 2):1159.

Cawley, J. (2010). The economics of childhood obesity. Health affairs, 29(3):364–371.

Cawley, J. and Spiess, K. (2008). Obesity and skill attainment in early childhood. Economics and Human Biology, 5:388–397.

Chang, H.-H. and Nayga, R. M. (2010). Childhood obesity and unhappiness: The influence of soft drinks and fast food consumption. Journal of Happiness Studies, 11(3):261–275.

Choukas-Bradley, S., Nesi, J., Widman, L., Galla, B. (2020) The Appearance-Related Social Media Consciousness Scale: Development and validation with adolescents, Body Image, 33: 164-174.

Comuzzie, A. G. and Allison, D. B. (1998). The search for human obesity genes. Science, 280(5368):1374–1377.

Cornelisse-Vermaat, J. R., Antonides, G., Van Ophem, J. A., and Van Den Brink, H. M. (2006). Body mass index, perceived health, and happiness: Their determinants and structural relationships. Social Indicators Research, 79(1):143–158.

Deckelbaum, R. J. and Williams, C. L. (2001). Childhood obesity: the health issue. Obesity research, 9(S11):239S–243S.

Delgado-Floody, P., Caamaño-Navarrete, F., Martínez-Salazar, C., Jerez-Mayorga, D., Carter-Thuiller, B., García-Pinillos, F., and Latorre-Román, P. (2018). La obesidad infantil y su asociación con el sentimiento de infelicidad y bajos niveles de autoestima en niños de centros educativos públicos. Nutrición hospitalaria, 35(3):533–537.

Delgado-Floody, P., Guzmán-Guzmán, I. P., Caamaño-Navarrete, F., Jerez-Mayorga, D., Zulic-Agramunt, C., and Cofré-Lizama, A. (2021). Depression is associated with lower levels of physical activity, body image dissatisfaction, and obesity in chilean preadolescents. Psychology, Health & Medicine, 26(4):518–531.

Diener, E., Suh, E. M., Lucas, R. E., and Smith, H. L. (1999). Subjective well-being: Three decades of progress. Psychological bulletin, 125(2):276.

Erickson, S. J., Robinson, T. N., Haydel, K. F., and Killen, J. D. (2000). Are overweight children unhappy?: Body mass index, depressive symptoms, and overweight concerns in elementary school children. Archives of pediatrics & adolescent medicine, 154(9):931–935.

Feltman, C.E., Szymanski, D.M. (2018). Instagram Use and Self-Objectification: The Roles of Internalization, Comparison, Appearance Commentary, and Feminism. Sex Roles 78, 311–324.

Friedman, K. E., Reichmann, S. K., Costanzo, P. R., and Musante, G. J. (2002). Body image partially mediates the relationship between obesity and psychological distress. Obesity research, 10(1):33–41.

Greve, J. (2016). Why do people with higher body weight earn lower wages? In The Oxford Handbook of Economics and Human Biology.

Griffiths, L. J., Wolke, D., Page, A. S., and Horwood, J. (2006). Obesity and bullying: different effects for boys and girls. Archives of disease in childhood, 91(2):121–125.

Grilo, C. M. and Pogue-Geile, M. F. (1991). The nature of environmental influences on weight and obesity: a behavior genetic analysis. Psychological bulletin, 110(3):520.

Heo, M., Allison, D. B., Faith, M. S., Zhu, S., and Fontaine, K. R. (2003). Obesity and quality of life: Mediating effects of pain and comorbidities. Obesity Research, 11(2):209–216.

Herman, K. M., Hopman, W. M., and Rosenberg, M. W. (2013). Self-rated health and life satisfaction among canadian adults: associations of perceived weight status versus bmi. Quality of Life Research, 22(10):2693–2705.

Jansen, W., van de Looij-Jansen, P. M., de Wilde, E. J., and Brug, J. (2008). Feeling fat rather than being fat may be associated with psychological well-being in young dutch adolescents. Journal of Adolescent Health, 42(2):128–136.

Jones, C. D. (2004). Body Image Among Adolescent Girls and Boys: A Longitudinal Study. Developmental Psychology, 40(5), 823–835.

Judge, S. and Jahns, L. (2007). Association of overweight with academic performance and social and behavioral problems: an update from the early childhood longitudinal study. Journal of School Health, 77(10):672–678.

Katsaiti, M. S. (2012). Obesity and happiness. Applied Economics, 44(31):4101–4114.

Kiviet, J. F. (2020). Testing the impossible: identifying exclusion restrictions. Journal of Econometrics, 218(2):294–316.

Lee, C. M. Y., Huxley, R. R., Wildman, R. P., and Woodward, M. (2008). Indices of abdominal obesity are better discriminators of cardiovascular risk factors than bmi: a meta-analysis. Journal of clinical epidemiology, 61(7):646–653.

Lindeboom, M., Lundborg, P., and Van Der Klaauw, B. (2010). Assessing the impact of obesity on labor market outcomes. Economics & Human Biology, 8(3):309–319.

Liu, Y., Xu, L., and Hagedorn, A. (2020). How is obesity associated with happiness? Evidence from china. Journal of Health Psychology, page 1359105320962268.

Mond, J., Van den Berg, P., Boutelle, K., Hannan, P., and Neumark-Sztainer, D. (2011). Obesity, body dissatisfaction, and emotional well-being in early and late adolescence: findings from the project eat study. Journal of Adolescent Health, 48(4):373–378.

Myers, T., Ridolfi, D., Crowther, J., Ciesla, J. (2012). The impact of appearance-focused social comparisons on body image disturbance in the naturalistic environment: The roles of thin-ideal internalization and feminist beliefs, 9(3):342-351.

Palermo, T. M. and Dowd, J. B. (2012). Childhood obesity and human capital accumulation. Social Science & Medicine, 75(11):1989–1998.

Park, S. and Jang, H. (2018). Correlations between suicide rates and the prevalence of suicide risk factors among korean adolescents. Psychiatry research, 261:143–147.

Perez-Truglia, R. (2015). A samuelsonian validation test for happiness data. Journal of Economic Psychology, 49:74–83.

Perloff, R.M. (2014) Social Media Effects on Young Women's Body Image Concerns: Theoretical Perspectives and an Agenda for Research. Sex Roles 71, 363–377.

Puhl, R. and Latner, J. (2007). Stigma, obesity, and the health of the nation's children. Psychological Bulletin, 133(4):557–580.

Rouse, K. and Hunziker, B. (2020). Child bodyweight and human capital: Test scores, teacher assessments and noncognitive skills. Economics of Education Review, 79:102042.

Russell-Mayhew, S., McVey, G., Bardick, A., and Ireland, A. (2012). Mental health, wellness, and childhood overweight/obesity. Journal of obesity, 2012.

Sabia, J. J. (2007). The effect of body weight on adolescent academic performance. Southern Economic Journal, pages 871–900.

Sabia, J. J. and Rees, D. I. (2015). Body weight, mental health capital, and academic achievement. Review of Economics of the Household, 13(1):653–684.

Sato, K. (2021). Unhappy and happy obesity: A comparative study on the united states and china. Journal of Happiness Studies, 22:1259–1285.

Scholder, S. v. H. K., Smith, G. D., Lawlor, D. A., Propper, C., and Windmeijer, F. (2012). The effect of fat mass on educational attainment: examining the sensitivity to different identification strategies. Economics & Human Biology, 10(4):405–418.

Sheslow, D., Hassink, S., Wallace, W., and DeLancey, E. (1993). The relationship between self-esteem and depression in obese children. Annals of the New York Academy of Sciences, 699:289–291.

Shin, N. Y. and Shin, M. S. (2008). Body dissatisfaction, self-esteem, and depression in obese korean children. The Journal of pediatrics, 152(4):502–506.

Strauss, R. (2000). Childhood obesity and self-esteem. Pediatrics, 105(1):1–5.

Stunkard, A. J., Faith, M. S., and Allison, K. C. (2003). Depression and obesity. Biological psychiatry, 54(3):330–337.

Stutzer, A. and Meier, A. N. (2016). Limited self-control, obesity, and the loss of happiness. Health Economics, 25(11):1409–1424.

Sutaria, S., Devakumar, D., Yasuda, S. S., Das, S., and Saxena, S. (2019). Is obesity associated with depression in children? systematic review and meta-analysis. Archives of disease in childhood, 104(1):64–74.

Walter, O. and Shenaar-Golan, V. (2017). Effect of the parent–adolescent relationship on adolescent boys' body image and subjective well-being. American journal of men's health, 11(4):920–929.

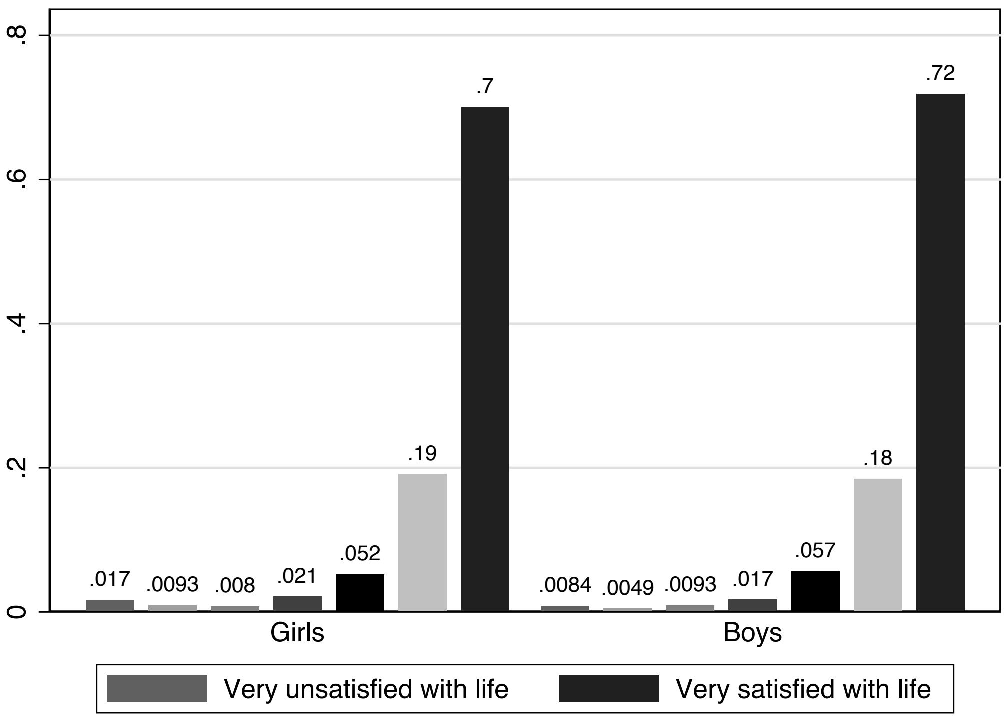
Willage, B. (2018). The effect of weight on mental health: New evidence using genetic ivs. Journal of health economics, 57:113–130.

Yen, C.-F., Liu, T.-L., Ko, C.-H., Wu, Y.-Y., and Cheng, C.-P. (2014). Mediating effects of bullying involvement on the relationship of body mass index with social phobia, depression, suicidality, and self-esteem and sex differences in adolescents in taiwan. Child abuse & neglect, 38(3):517–526.

Zeng, Q. and Yu, X. (2019). Overweight and obesity standards and subjective well-being: Evidence from china. Economics & Human Biology, 33:144–148.

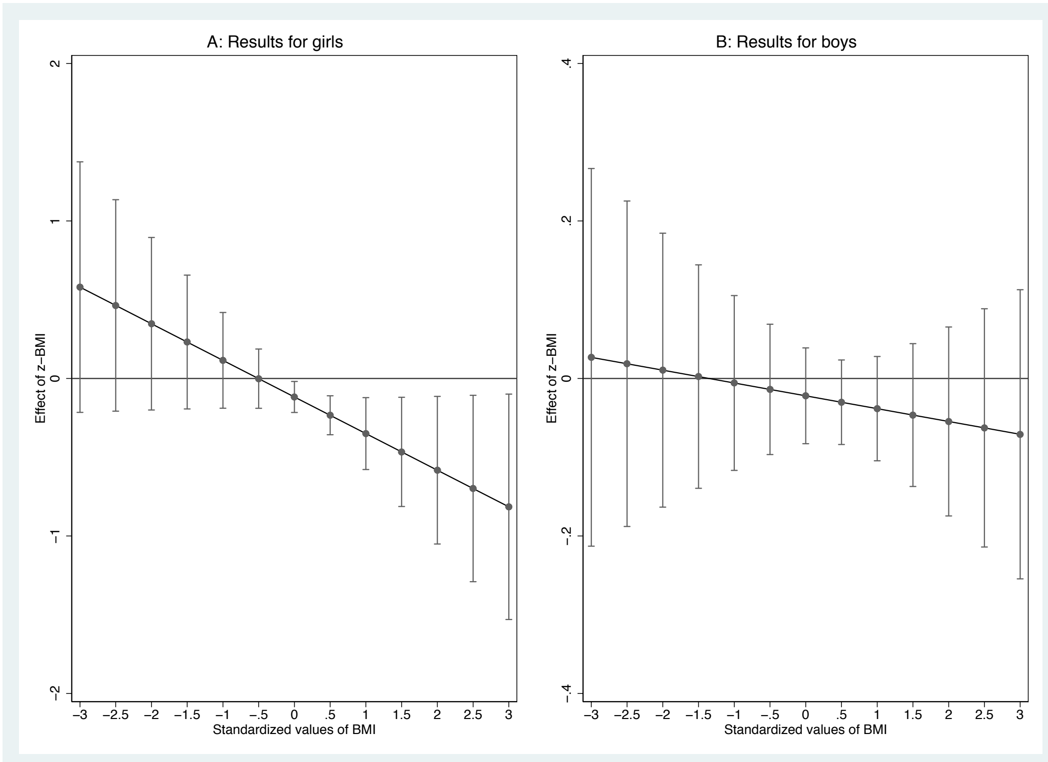
Figures

Figure 1: Distribution of LS for girls and boys.



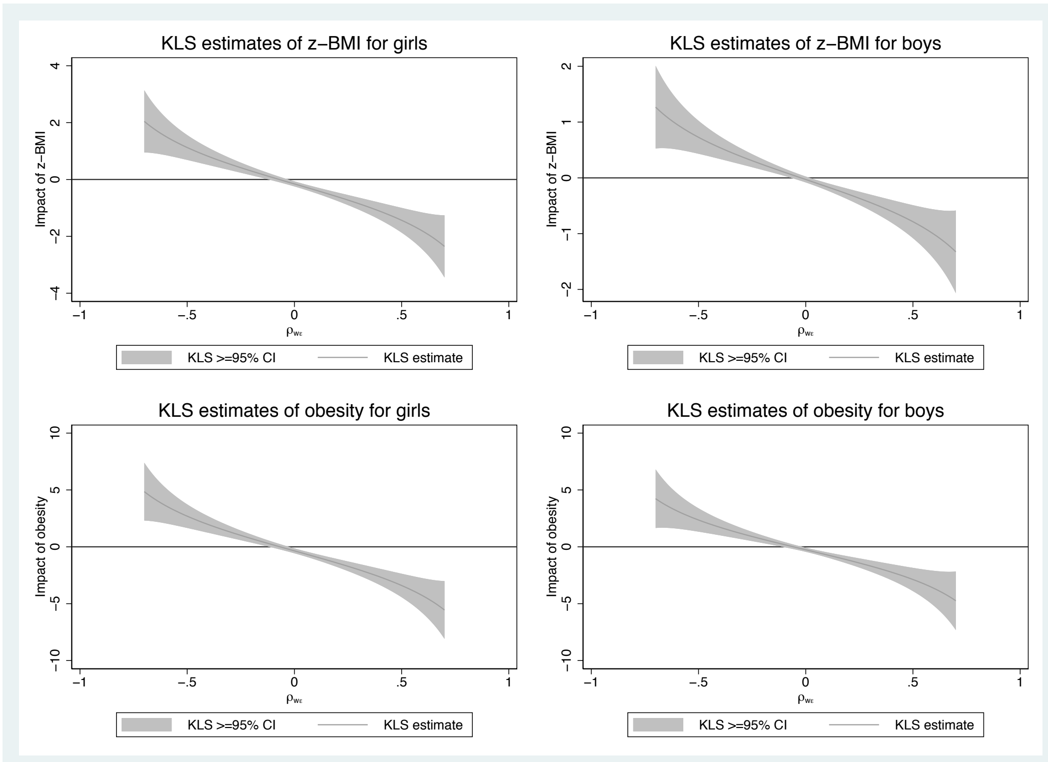
Notes: Own elaboration based on ELPI 2017 and the sample used in the main regression.

Figure 2: Non-linear relationship between bodyweight and life satisfaction: 95% CI



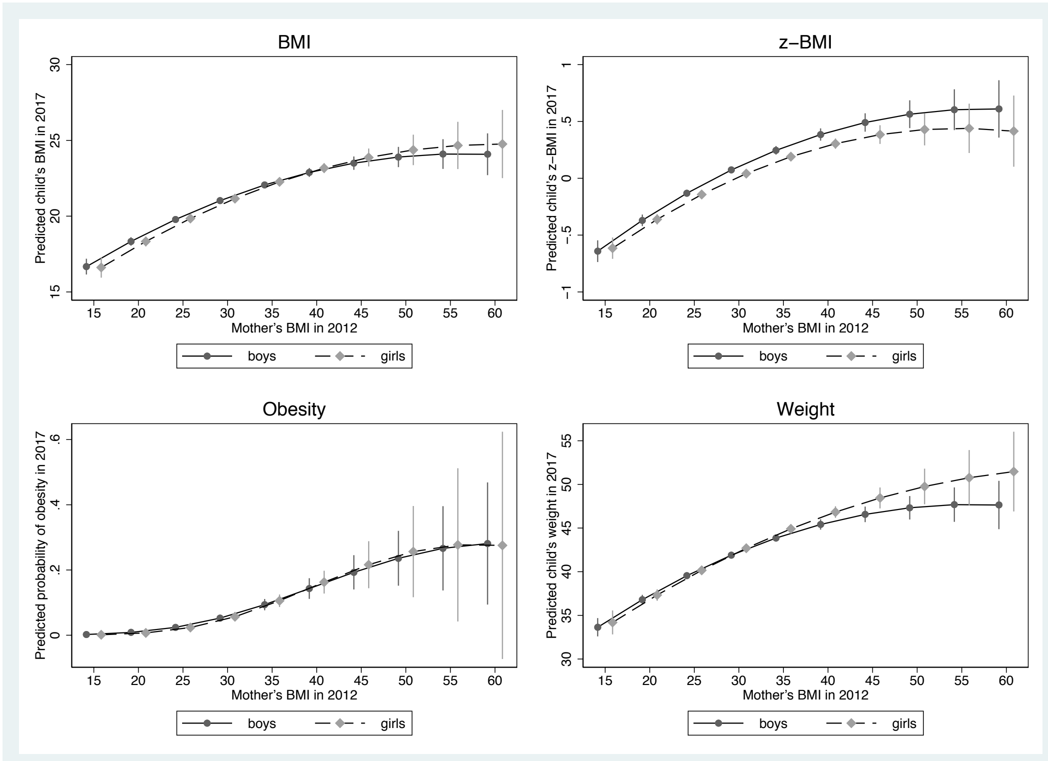
Note: Each graph shows the 95% interval OLS-estimates of the impact of z-BMI on LS using a quadratic specification and the same controls as in 2.

Figure 3: Kinky least squares estimates for z-BMI and obesity: 95% CI



Note: We control for the same controls as in Table 2.

Figure 4: Relationship between children's bodyweight and mothers' BMI: 95% CI



Note: Each graph shows the conditional predicted values of BMI, z-BMI, weight (controlling for height) and obesity. The predicted values for obesity are obtained using a Probit model. We use quadratic specifications and control for the same controls as in Table 2.

Tables

Table 1: Summary statistics

	Girls			Boys		
	Mean	SD	N	Mean	SD	N
Children covariates:						
Life satisfaction	6.46	1.13	2256	6.54	0.96	2262
Weight	46.44	11.69	2256	45.27	11.34	2262
Height	146.99	8.21	2256	145.72	8.26	2262
Child's BMI	21.29	4.13	2256	21.13	4.06	2262
Child's z-BMI	-0.04	0.52	2256	-0.01	0.75	2262
Obese	0.05	0.21	2256	0.05	0.22	2262
Child's age in months	133.74	7.8	2256	133.98	7.7	2262
Number of older siblings	0.67	0.82	2256	0.7	0.82	2262
Number of younger siblings	0.54	0.69	2256	0.57	0.71	2262
Hosehold covariates:						
Father in the house	0.58	0.49	2256	0.58	0.49	2262
ln(Household income)	13.41	1.37	2256	13.43	1.51	2262
Household size	4.48	1.52	2256	4.52	1.46	2262
Number of meals with family	2.49	0.81	2256	2.54	0.78	2262
Mother's covariates:						
Education (in years)	11.78	3.21	2256	11.83	3.21	2262
Age (in years)	37.42	6.96	2256	37.64	7.04	2262
Household head	0.44	0.5	2256	0.45	0.5	2262
Married	0.4	0.49	2256	0.41	0.49	2262
Cohabitating	0.26	0.44	2256	0.26	0.44	2262
Separated/divorce	0.09	0.29	2256	0.1	0.3	2262
Single	0.24	0.43	2256	0.22	0.42	2262
Widowed	0.01	0.11	2256	0.01	0.07	2262
Depression in 2017	0.29	0.45	2256	0.27	0.44	2262
Post-partum depression	0.1	0.3	2256	0.1	0.3	2262
Smoked during pregancy	0.09	0.29	2256	0.1	0.3	2262
Drunk during pregnancy	0.07	0.26	2256	0.07	0.26	2262
Used drugs during pregnancy	0.01	0.08	2256	0.01	0.1	2262
Month of breastfeeding	14.89	11.74	2256	15.11	11.57	2262
Instrument:						
Mother's BMI in 2012	28.46	5.4	1899	28.13	5.31	1889
Mediators:						
BI satisfaction	2.52	0.78	2256	2.48	0.77	2260
Bullying score	15.45	4.01	2256	15.32	3.94	2260
Comorbidities	0.13	0.33	2256	0.15	0.35	2262
N	4518					

Notes: Own elaboration based on ELPI 2017 and the sample used in the main regression.

Table 2: Bodyweight and mediator variables: OLS specifications

	All			Girls			Boys		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	BIS	Bullying	Bad health	BIS	Bullying	Bad health	BIS	Bullying	Bad health
Panel A									
z-BMI	-0.110***	0.156**	0.024***	-0.192***	0.407**	0.045***	-0.068***	0.031	0.013
	(0.016)	(0.064)	(0.006)	(0.036)	(0.153)	(0.01)	(0.02)	(0.134)	(0.009)
N	4,516	4,516	4,518	2,256	2,256	2,256	2,260	2,260	2,262
R2	0.028	0.021	0.012	0.043	0.042	0.013	0.019	0.005	0.013
Panel B									
Obese	-0.298***	1.038***	0.040**	-0.273***	1.107***	0.042**	-0.335***	1.075*	0.04
	(0.053)	(0.293)	(0.015)	(0.075)	(0.294)	(0.017)	(0.067)	(0.601)	(0.036)
N	4,516	4,516	4,518	2,256	2,256	2,256	2,260	2,260	2,262
R2	0.026	0.023	0.01	0.032	0.043	0.009	0.023	0.008	0.013
Panel C									
Weight	-0.010***	0.023***	0.002***	-0.011***	0.027***	0.003***	-0.008***	0.02	0.002**
	(0.001)	(0.004)	(0.000)	(0.002)	(0.008)	(0.001)	(0.002)	(0.012)	(0.001)
Height	0.008***	-0.025***	-0.002**	0.008**	-0.031**	-0.002	0.007***	-0.025***	-0.001
	(0.002)	(0.007)	(0.001)	(0.003)	(0.012)	(0.001)	(0.002)	(0.007)	(0.001)
N	4,516	4,516	4,518	2,256	2,256	2,256	2,260	2,260	2,262
R2	0.031	0.023	0.013	0.044	0.042	0.012	0.021	0.006	0.014

Notes: Clustered standard errors at spatial-unit level in parenthesis. Child´s controls include: age in months, age squared, older siblings and younger siblings. Household´s controls: region, logarithm of monthly household income, whether the child lives with biological father, household size and meals. Mother´s controls: schooling, age, household head, depression, months of breastfeeding, post-partum depression, risky behaviour during pregnancy, and marital status. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 3: Life satisfaction and bodyweight among children: OLS specifications

	Girls					Boys				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A										
z-BMI	-0.155***	-0.087**	-0.134***	-0.150***	-0.080**	-0.029	-0.008	-0.027	-0.028	-0.009
	(0.034)	(0.033)	(0.036)	(0.033)	(0.033)	(0.023)	(0.026)	(0.023)	(0.023)	(0.025)
BIS		0.354***			0.302***		0.294***			0.253***
		(0.026)			(0.028)		(0.035)			(0.034)
Bullying			-0.052***		-0.035***			-0.046***		-0.035***
			(0.01)		(0.01)			(0.007)		(0.007)
Bad health				-0.108*	-0.062				-0.089	-0.075
				(0.06)	(0.051)				(0.057)	(0.058)
N	2,256	2,256	2,256	2,256	2,256	2,262	2,260	2,260	2,262	2,260
R2	0.017	0.074	0.049	0.018	0.087	0.007	0.061	0.042	0.008	0.08
% Reduction in bodyweight coefficient		44	14	3	48		72	8	4	69
Panel B										
Obese	-0.353***	-0.255***	-0.296**	-0.348***	-0.228**	-0.258	-0.161	-0.209	-0.254	-0.134
	(0.100)	(0.083)	(0.100)	(0.100)	(0.087)	(0.148)	(0.144)	(0.140)	(0.149)	(0.136)
BIS		0.357***			0.305***			0.291***		0.251***
		(0.025)			(0.028)			(0.035)		(0.034)
Bullying			-0.052***		-0.035***			-0.046***		-0.035***
			(0.010)		(0.010)			(0.007)		(0.006)
Bad health				-0.118*	-0.066				-0.087	-0.074
				(0.062)	(0.052)				(0.057)	(0.057)
N	2,256	2,256	2,256	2,256	2,256	2,262	2,260	2,260	2,262	2,260
R2	0.017	0.075	0.049	0.018	0.088	0.01	0.062	0.044	0.01	0.081
% Reduction in bodyweight coefficient		28	16	1	35		38	19	1	48
Panel C										
Weight	-0.009***	-0.005**	-0.008***	-0.009***	-0.004**	-0.008**	-0.006*	-0.007**	-0.008**	-0.005
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Height	0.004	0.001	0.002	0.003	0.000	0.010***	0.008**	0.009**	0.010***	0.007**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
BIS		0.354***			0.301***		0.290***			0.249***
		(0.026)			(0.028)		(0.035)			(0.034)
Bullying			-0.052***		-0.035***			-0.046***		-0.035***
			(0.010)		(0.010)			(0.007)		(0.007)
Bad Health				-0.108	-0.062				-0.081	-0.07
				(0.061)	(0.052)				(0.058)	(0.058)
N	2,256	2,256	2,256	2,256	2,256	2,262	2,260	2,260	2,262	2,260
R2	0.017	0.074	0.05	0.018	0.087	0.011	0.063	0.045	0.012	0.082
% Reduction in bodyweight coefficient		45	11	0	56		25	12	0	38

Notes: Clustered standard errors at spatial-unit level in parenthesis. The control variables are the same as those in Table 2. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 4: Association between children's LS and mother's BMI

	Girls		Boys	
	-1	-2	-3	-4
Lagged mother's BMI	−0.005	−0.006	−0.011*	−0.010*
	(0.004)	(0.004)	(0.006)	(0.005)
Child's z-BMI	−0.147***		−0.014	
	(0.042)		(0.036)	
Obese		−0.393***		−0.119
		(0.100)		(0.162)
N	1, 899	1, 899	1, 889	1, 889

Notes: Clustered standard errors at spatial-unit level in parenthesis. The control variables are the same as those in Table 2. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 5: Balance of covariates between non-obese and obese mother

	Girls			Boys		
	Non-Obese	Obese	Difference	Non-Obese	Obese	Difference
Child's age in months	133.786	133.772	0.014	134.015	133.756	0.259
Number of older siblings	0.644	0.79	-0.146***	0.706	0.781	-0.074*
Number of younger siblings	0.539	0.477	0.062*	0.548	0.54	0.009
Father in the house	0.579	0.609	-0.03	0.576	0.632	-0.056**
Ln (Household income)	13.412	13.333	0.08	13.471	13.328	0.144*
Household size	4.441	4.565	-0.125*	4.518	4.55	-0.032
Number of meals with family	2.474	2.543	-0.069*	2.52	2.572	-0.051
Mother's education (in years)	12.062	11.011	1.050***	12.069	11.108	0.962***
Mother's age	37.316	38.221	-0.905***	37.687	38.428	-0.742**
Household head	0.43	0.441	-0.011	0.436	0.439	-0.003
Married	0.399	0.41	-0.011	0.414	0.405	0.009
Cohabitating	0.255	0.27	-0.014	0.255	0.299	-0.044**
Separated/divorce	0.087	0.097	-0.01	0.105	0.103	0.002
Single	0.242	0.215	0.027	0.219	0.188	0.031
Widowed	0.016	0.008	0.008	0.007	0.005	0.001
Mother's depression	0.278	0.341	-0.063***	0.245	0.329	-0.084***
Smoked during pregancy	0.082	0.107	-0.025*	0.099	0.103	-0.004
Drunk during pregnancy	0.07	0.071	-0.002	0.067	0.076	-0.009
Used drugs during pregnancy	0.007	0.01	-0.003	0.011	0.004	0.007
Month of breastfeeding	14.776	15.142	-0.366	14.733	16.016	-1.283**
Post-partum depression	0.095	0.108	-0.013	0.103	0.099	0.004
N	1899			1889		

Notes: Obese mothers are those whose BMI was equal or greater than 30 in 2012. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 6: Life satisfaction and bodyweight: IV specifications

	Girls					Boys				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A										
z-BMI	-0.293**	-0.194	-0.229	-0.275**	-0.153	-0.282**	-0.214*	-0.249**	-0.282**	-0.200
	0.131)	(0.138)	(0.144)	(0.128)	(0.146)	(0.115)	(0.123)	(0.120)	(0.114)	(0.124)
BIS		0.353***			0.302***		0.287***			0.246***
		(0.038)			(0.045)		(0.029)			(0.029)
Bullying			-0.052***		-0.036***			-0.045***		-0.034***
			(0.011)		(0.011)			(0.006)		(0.005)
Bad health				-0.123**	-0.080*				-0.107*	-0.108*
				(0.049)	(0.043)				(0.063)	(0.059)
N	1,899	1,899	1,899	1,899	1,899	1,889	1,887	1,887	1,889	1,887
F-stat	224.088	230.755	218.59	235.825	236.701	273.34	297.488	266.596	270.711	284.046
% Reduction in bodyweight coefficient		34	22	6	48		24	12	0	29
Panel B										
Obese	-1.078**	-0.715	-0.853*	-1.003**	-0.563	-1.412***	-1.083***	-1.254**	-1.412***	-1.019*
	(0.450)	(0.490)	(0.512)	(0.438)	(0.523)	(0.488)	(0.544)	(0.524)	(0.485)	(0.555)
BIS		0.353***			0.304***		0.272***			0.236***
		(0.038)			(0.045)		(0.032)			(0.031)
Bullying			-0.050***		-0.034***			-0.041***		-0.031***
			(0.012)		(0.012)			(0.006)		(0.005)
Bad health				-0.139***	-0.089**				-0.084	-0.091
				(0.051)	(0.045)				(0.066)	(0.060)
N	1,899	1,899	1,899	1,899	1,899	1,889	1,887	1,887	1,889	1,887
F-stat	73.777	73.182	76.937	73.248	74.855	54.408	53.522	56.846	55.161	55.336
% Reduction in bodyweight coefficient		34	21	7	48		23	11	0	28
Panel C										
Weight	-0.017**	-0.011	-0.013	-0.016**	-0.008	-0.024**	-0.018*	-0.021**	-0.024***	-0.017*
	(0.008)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.010)
Height	0.009	0.004	0.005	0.008	0.002	0.023**	0.018*	0.021**	0.023**	0.017*
	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.011)	(0.009)	(0.009)	(0.010)
BIS		0.353***			0.302***		0.285***			0.246***
		(0.038)			(0.045)		(0.029)			(0.029)
Bullying			-0.052***		-0.036***			-0.044***		-0.033***
			(0.011)		(0.011)			(0.006)		(0.005)
Bad health				-0.124**	-0.080*				-0.094	-0.098*
				(0.050)	(0.044)				(0.060)	(0.056)
N	1,899	1,899	1,899	1,899	1,899	1,889	1,887	1,887	1,889	1,887
F-stat	138.8	136.749	137.518	138.588	136.449	260.391	287.871	266.822	259.421	288.034
% Reduction in bodyweight coefficient		35	24	6	53		25	13	0	29

Notes: Clustered standard errors at spatial-unit level in parenthesis. The control variables are the same as those in Table 2.
*p < 0.1, **p < 0.05, ***p < 0.01.

A Appendix A: ECLIS test

The question used by ECLIS test are the following.

Next, you must read a series of questions about yourself at school. In front of each one of them you must select the answer on the Tablet that represents what you think about what is being asked (Answers: never, rarely, almost always, never)

- My classmates make fun of me, they give me nicknames.
- I feel alone in my class.
- I have a good time with my classmates.
- My classmates are very aggressive.
- My classmates fight a lot.
- My classmates like to make other suffer.
- I have a hard time in the classroom.
- My classmates like to give nicknames.

B Appendix B: Additional tables and figures

Table B.1: Marginal Effects on Pr (Bad Health=1)

	All			Girls			Boys		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
z-BMI	0.024***			0.045***			0.014		
	(0.007)			(0.010)			(0.009)		
Obese		0.042***			0.045***			0.043	
		(0.0016)			(0.017)			(0.039)	
Weight			0.002***			0.003***			0.002**
			(0.000)			(0.001)			(0.001)
Height			-0.002**			-0.002*			-0.001
			(0.001)			(0.001)			(0.001)
N	4518	4518	4518	2223	2223	2223	2262	2262	2262

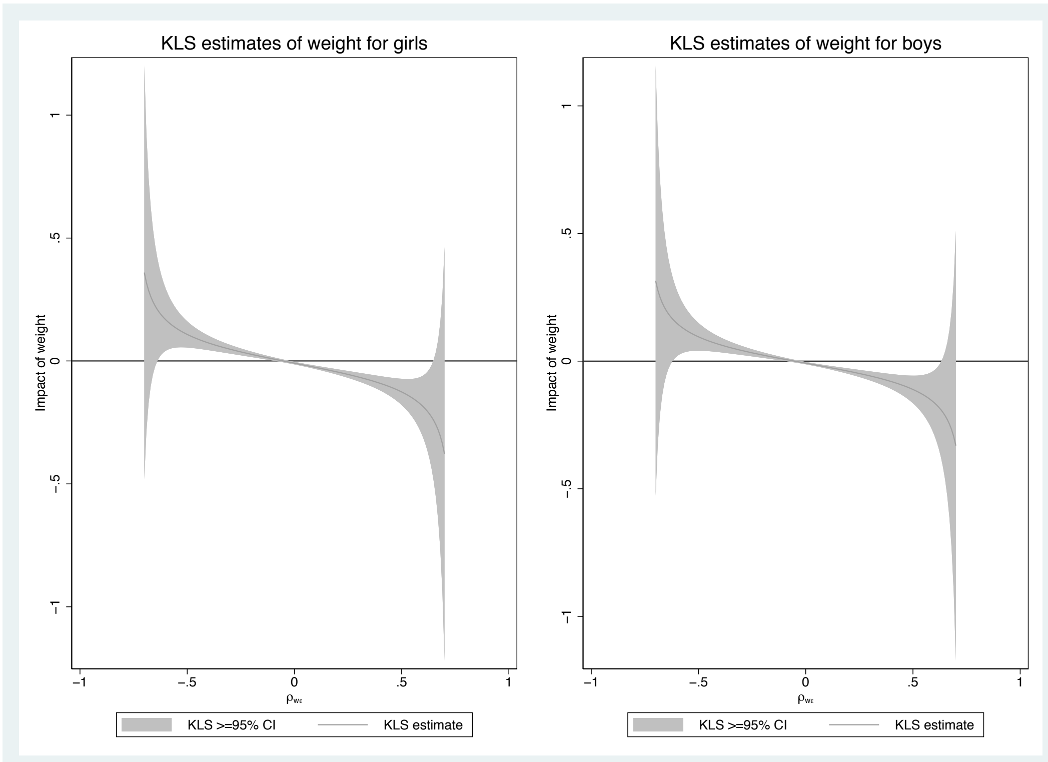
Notes: The estimates report the average marginal effects (AME) for a Probit model. Clustered standard errors at spatial-unit level in parenthesis. The control varibales are the same as those in Table 2. *p < 0.1, **p < 0.05, ***p < 0.01.

Table B.2: Pooled IV estimates with gender interactions

	(1)	(2)	(3)
z-BMI	-0.282**		
	(0.130)		
z-BMI x boy	-0.012		
	(0.232)		
Obese		-1.071**	
		(0.442)	
Obese x boy		-0.379	
		(0.857)	
Weight			-0.017**
			(0.007)
Weight x boy			-0.005
			(0.013)
N	3788	3788	3788
F-stat	103.622	30.531	91.452

Notes: Clustered standard errors at spatial-unit level in parenthesis. The control variables are the same as those in Table 2. *p < 0.1, **p < 0.05, ***p < 0.01.

Figure B.1: Kinky least squared estimates for weight: 95% CI



Note: The KLS approach corrects the bias of the OLS estimator analytically assuming the degree of endogeneity $\rho_{w,e}$. The asymptotically conservative CIs are obtained as the union of the CIs over the considered grid. The control variables are the same as those Table 2 and height.