Vertical Transmission of Overweight:

Evidence from English Adoptees

Mireia Jofre-Bonet, Joan Costa-Font & Julian Le Grand

Vertical Transmission of Overweight: Evidence from English Adoptees

Jofre-Bonet, Mireia [*1,2], Costa-Font, Joan[2], and

Le Grand, Julian[2]

[1]Department of Economics, City University London

[2]LSE Health and Social Care, London School of Economics

October 11, 2016

Abstract

We examine the vertical transmission of overweight drawing upon a sample of English children, both adopted and non-adopted, and their families. Our results suggest strong evidence of an inter-generational association of overweight between adopted children and their adoptive parents, indicating transmission through cultural factors. We find that, when both adoptive parents are overweight, the likelihood of an adopted child being overweight is between 10 and 20 percentage points higher than when they are not. We also find that the cultural transmission of overweight is not aggravated by having a full-time working mother, so do not confirm the existence of a female labour market participation penalty on child overweight among adoptees. Overall, our findings are robust to a battery of robustness checks and specifications.

JEL: I18, D13, Z1

Keywords: Vertical Transmission, Cultural Transmission, Overweight, Children, Natural parents, Body Mass Index, Sample Selection.

1 Introduction

Overweight and obesity, as a form of extreme overweight in children is of growing concern. Evidence from the Health Survey for England suggests that the prevalence of overweight among 2-10 (11-15) year-olds averaged over the three years 2010 to 2012 was as high as 26% (35%), and obesity 13% (9%).[1] Nor is the situation any better in other parts of the United Kingdom (UK).[2] Even more concerning, estimates from the International Association for the Study of Obesity (IASO, 2011) indicate that the rates of overweight (including obese) children aged 5-17 years in the UK are among the highest in Europe and have experienced an increasing trend in the last decade, with a corresponding associated rising burden of morbidity (Berenson et al, 1993).

The mechanisms contributing to what might fairly be described as a childhood overweight epidemic are contentious, as are the appropriate policy interventions. A major problem for policy intervention is the identification of the relative importance of hereditary factors and environmental ones. Childhood obesity is found to be partly heritable in studies of identical twins, but the estimates vary from 37 to 90% (Llewellyn 2003). Although we do not attempt to provide a comprehensive review of the growing literature on transmission of obesity, recent estimates using adoptees vary from 20 to 60% (Elks et al, 2012). In contrast, overweight in children seems to be significantly more influenced by the specific individual cultural (including family) environment (Koeppen-Schomerus et al, 2001). Yet, identifying the roles of different factors is important for the purposes of any policies aimed at

---

[1]Public Health England Child Weight Data Fact Sheet August 1914. http://www.noo.org.uk/securefiles/141007_1330/ChildWeight_Aug2014_v2.pdf.

[2]Public Health England. http://www.noo.org.uk/NOO_about_obesity/child_obesity/UK_prevalence.

dealing with the epidemic. If overweight is entirely genetic, then, short of a degree of genetic manipulation that is likely to be both technically infeasible and socially unacceptable, there is only a limited set of policy options available (Manski, 2012). If, on the other hand, there is a significant cultural or environmental component in transmission, then there is room for policy intervention; but that component needs to be identified so that policy can be properly targeted.

Identifying the role of parents seems particularly important. It is possible that the spread of overweight among children can be attributed in large part to the influence of parental norms, including unhealthy role modelling. Children may consciously or unconsciously observe and model their parents especially with regards to fitness and to food consumption. Indeed, there is evidence that children's caloric intake, diet habits, level of physical activity and health behaviour in general are, at least partially, dictated by their parents' health behaviour and culturally determined social norms (Anderson and Butcher, 2006).

In this paper, we address the question concerning the existence and magnitude of the parental cultural influence on children's overweight in England. Our paper contributes to the existing literature by shedding some light to the question of how transmittable are overweight and obesity. Although Sacerdote (2007) found little evidence that that overweight is transmitted from parents to adopted children, the generalizability of these findings may be limited by the fact that the study uses a quasi-random design focusing on Korean adoptees in the US and that Koreans rates of obesity and overweight are among the lowest of the world (OECD, 2015). On the other hand, Koeppen-Schomerus et al. (2001) uses twin studies and provides evidence that overweight is not highly hereditable. To speak to such debate, our study

3

draws upon all the thirteen waves of the Health Survey for England (HSE) to construct a unique dataset containing children living in homes with either two biological parents or two adoptive parents. Besides the nature of the child-parent relationship, the data include information on a range of children's and parents' characteristics; on parental lifestyles; and on validated anthropometric records on children´s overweight. These data allow us to identify the magnitude of the cultural transmission of overweight and obesity by quantifying the differences in the degree of transmission from parents to children between those children living with two biological parents and those living with two strictly[3] adoptive parents. Our estimates control not only for children's characteristics, parents' traits and other common environmental factors, but also for sample selection bias resulting from adoption not being a random event, with some sorts of households being more likely to adopt a child than others. Additionally, we contribute to a contentious point in the literature about whether maternal full-time employment alters the transmission of overweight, even when genetic transmission is not having an effect.

Our results reveal that when both adoptive parents are overweight, the likelihood of an adopted child being overweight is between 10% and 20% higher than when they are not, a result that we attribute to cultural/environmental transmission of overweight. We also find that the cultural[4] transmission of overweight from parents to children is not aggravated by having a full-time working mother. Nevertheless, for natural children only, having a full-time working mother does significantly increase the positive effect of having an

---

[3]We exclude those living with genetically related adoptive parents.

[4]Throughout the text, we refer to cultural and environmental transmission indistinguishably.

obese father on the likelihood of the child being overweight or obese.[5]

The remainder of the paper is organized as follows. Section 2 contains the model and outlines the empirical strategy. Section 3 describes our dataset. Section 4 reports our results. Section 5 discusses them, and Section 6 concludes.

2   2. Background and Empirical Strategy

Our empirical strategy is grounded on a health production function framework that allows the differentiation of genetic and environmental mechanisms in the inter-generational transmission of overweight. Health and non-health related traits of the parental environment influence some of the arguments in the child's production function creating links between the two generations. In our case, we adapt the model in Thompson (2014) of health vertical transmission by letting o_i indicate the overweight condition of the child i, and g_i and e_i the genetic and environmental factors influencing the weight of a child, respectively, so that $o_i = A(\alpha g_i^{\gamma} + (1 - \alpha)e_i^{1/\gamma})$ reflects both genes and the genetic predisposition to be overweight or obese. The factor e_i contains non-genetic influences, including socio-economic and environmental factors such as: age; gender; education; socio-economic and employment status; and urban versus rural dwelling. The inter-generational transmission stems from the fact that parents and children share with different degrees the arguments in the factors g_i and e_i. In this setting, when $\gamma = 1$ genes and environment have an additively separable influence on overweight status of the child and α and $1 - \alpha$ represent the relative weight that e_i and g_i have, respectively, in the likelihood of a child being overweight.

---

[5]Our measure of overweight includes obesity.

5

In our setting, we assume that being overweight has both genetic and environmental (or cultural) causes and that, as for other conditions, the specific interaction of genes and environmental factors will be crucial in determining whether a child is overweight. For instance, a predisposition of the parents to gain weight arguably may make them more aware of the nutritional content of food or of the need to do exercise, and this may translate in their children being exposed to healthier foods and more exercise, and ultimately less likely to be overweight. This model of transmission of overweight recommends distinguishing between sole maternal or paternal overweight from both parent's overweight. The latter would provide an additional reinforcing environmental effect.

As we explain below, we present estimates of different econometric specifications that compare the transmission of overweight across biological and adopted children. The results of the estimation for non-biological children should remove the shared genetic components of transmission. g_i. Moreover, since assignment to a given type of household (both biological parents; only one biological parent; and both adoptive parents) is not random, correcting for observable and unobservable sample biases will be crucial to identify non-genetic transmission of overweight. We correct for these biases to the extent that we can by using a Heckman selection model.

Our empirical strategy is to estimate a reduced form specification that draws upon the health production function above. We specify a linear model in which the latent overweight of a child is explained by non-genetic factors (age of the parents, their education and employment statuses, household's income, type of dwelling, and, being exposed to passive smoke); the child's own characteristics (age, gender, ethnic group); and, indicator variables taking value 1 if both parents being overweight; only the mother being overweight;

or only the father being overweight, respectively:

$$o_{ij}{}^* = \delta_0 + \delta_b o_{ij}{}^b + \delta_M o_{ij}{}^M + \delta_F o_{ij}{}^F + \beta Z_j + \phi X_{ij} + v_{ij}, (1)$$

where o_{ij}^* indicates the latent overweight of child i in household j; o_{ij}^b is an indicator variable for both parents of child i in household j being overweight or obese; o_{ij}^M takes value one if only the mother of child i in household j is overweight ; o_{ij}^F takes value one if only the father of child i in household j is overweight ; Z_j is a vector with the parents' characteristics and X_{ij} a vector of the child's characteristics; and v_{ij} is the error term.[6] Assuming normality of the error term, v_{ij}, the probability of observing that a child i in our sample is overweight ($o_{ij} = 1$) is the probability that the corresponding latent variable is positive, i.e.:

$$P(o_{ij} = 1) = P(o_{ij}^* > 0) = \Phi(\delta_0 + \delta_b o_{ij}{}^b + \delta_M o_{ij}{}^M + \delta_F o_{ij}{}^F + \beta Z_j + \phi X_{ij}) (2)$$

Therefore, coefficients $\delta_b, \delta_M,$and δ_F will estimate the effect of both parents, only the mother or only the father being overweight on the likelihood a child being overweight, respectively. The specification above is correct under the assumption that the specification controls for all possible factors that affect the likelihood of adoption. We estimate equation (2) for two different groups of children: those who live with both biological parents and those who live with both adoptive parents. The difference between the coefficients for children that are biological (exposed to both genetic and environmental transmission of overweight and those that are adopted (only to the environmental transmission), will give us a measure of the relative importance of environmental intergenerational transmission for overweight.

---

[6]Note that, given the data available in HSE, for children living with their natural parents, o_{ij}^M and o_{ij}^F refer to the overweight status of their biological parents. For children living with their adoptive parents, these terms will refer to the overweight condition of the adoptive parents.

We first estimate equation (2) using a Probit model, without taking into account the selection bias of children into each of these groups. Second, we perform robustness checks re-estimating equation (2) controlling for the sample selection bias of being in an adoptive family by using a probit models with sample selection[7] (heckprobit). The exclusion restriction for the identification of the Heckprobit models relies on the parents' age and the father being unemployed, which are likely to affect the likelihood of an individual being adopted but not the overweight of the child.[8] As an additional robustness check, we also estimate equation a variation of equation (2) using Ordinary Least Squares.

Additionally, we estimate equation (2) allowing the mother working full time to influence the degree of transmission of overweight from parents to children. We do so by interacting the indicator variable taking value 1 when the mother works full time with the overweight indicator variables for the parents.[9] We have considered additional specifications including the specific transmission of mother-daughter and father-son; and whether the transmission has evolved with each wave of the survey, i.e. over time. We do not include these results as sample limitations hampered the robustness of the coefficients.

---

[7]i.e., Maximum-Likelihood probit models with sample selection as in Van de Ven and Van Praag (1981).

[8]In our favor, the percentage of unemployed fathers and the father's age for the sample of children living with their natural parents are significantly different than that for the sample of children living with their adoptive parents.

[9]We also estimated the model using families in which one of the parents is biological and the other is not but given that the baseline characteristics of this type of households are markedly significantly different from the natural and adoptive parents' families, we do not present it in here

3   Data

The dataset we use to estimate the models above originates in the Health Survey for England (HSE). The HSE is an annual cross-sectional survey designed to measure health and health-related behaviours, including weight and height, body mass index (BMI), fruit and vegetable consumption, alcohol consumption and smoking in adults and children living in private households in England. The survey also contains the socio-economic status of the household and core information on all its members, including their relationship. This allows us to categorize children in types of households depending on whether they live with both their biological parents or they live with a set of parents neither of whom is biological and unrelated genetically.[10] Our pooled cross-section panel dataset results from merging information contained in thirteen different waves of the HSE, from 1997 to 2009.

Adoption in the UK can be legally carried out by parents that are over 21 years of age that have at least one year of residency and have a fixed permanent home in the UK irrespective of the civil status. The latter includes the possibility of the partner of the natural parent to being considered 'adopter parent' too (UK Government, 2013)[11] , in which case is labelled as 'step child'. The process of adoption takes place after an application to an adoption agency (whether a council or a privately run one). The conditions to be met to be regarded as suitable include a full medical examination, a police check of no pre-existing convictions, including three-reference letters, training and an assessment by a social worker. Recommendations regarding

---

[10]As we have the relationship between children and all relatives in the household, our sample does not include children living with 'non-parents' but biologically related family members, i.e. grandparents, uncles, aunts, etc.

[11]https://www.gov.uk/child-adoption

suitability of an adopter parent are made by an external 'adoption panel'. Once an adoption panel makes decisions, then the parents are matched with a child locally or referred to the Adoption Registry[12] and, typically, adoption refers not non-family members.[13] Usually the Department of Education applies means tested fee for adopter families to pay ranging from 885£ to 1775£ (UK Government, 2013).

Because of the nature of our dataset, we are confronted with several limitations. First, we do not have information on the biological parents of the adopted children. Thus, we cannot control for early nutrition effects they may have faced and we cannot observe the weight of the biological parents. Second, we cannot identify the exact time of adoption, and can only indirectly control for it through age. Third, we cannot identify whether if the individuals were born overseas although we do have their ethnicity information.

More generally, studies using data from adoptees face challenges that complicate the identification strategy (Holmlund et al, 2011). Parental sorting is not random. Adoption agencies often place infants selectively by matching natural and adoptive parent characteristics, such as education, occupation, and impressions about intelligence" (Scarr and Weinberg, 1994). Thus, if the genetic influence of the biological parents is not accounted for, statistical associations between the outcomes of adopted children and their adoptive parents could reflect a combination of the adoptive parents' environmental influences and the correlated genetic inheritance. A way to partially address this is to

---

[12]Recent data from Adoption UK suggest that 75% of adopted children are between 1 and 4 years of age, 73% were from a white British background and 91% of the adoptees were adopted by couples as opposed to single individuals. The number of adoptees was gender balanced, as 52% were boys and the remainder were girls (UK Government, 2013).

[13]As authorities close relates are typically asked before a child is put on adoption.

correct for sample selection into adoptive families using the characteristics of the child and the foster parents. Using this approach, Bjorklund et al (2006) find no evidence of the existence of a sample selection bias as estimates between adoptees and biological parents in Sweden; Sacerdote (2007) uses a sample of American Korean adoptees quasi-randomly assigned to adoptive families and finds evidence of cultural transmission of some health behaviours and BMI. In our case, we go extend the analysis in several directions: First, we use a measure of overweight and obesity of both parents and children obtained from weight and height data measured by a nurse during the survey instead of relying on BMI. Having socioeconomic information of both parents for all children allows to control for the potential compounding effect of assortative mating. Second, we are able to correct for potential sample selection biases based on observables due to selective adoptee placement and the different characteristics of the adoptive families. Third, we run a battery of subsample analyses and robustness checks to investigate the stability of our estimates.

In this paper, we limit the source of disparity between our sample of biological and adoptive families by restricting our analysis to two-parent households. Even though we one can argue for the existence of selection of adoptees, adopter parents typically compensate for the (negative) effects of adoption on health behaviors, which can explain that in our analysis we find limited evidence of selection.

Our final dataset contains children of all waves, including their socio-demographic characteristics, their physical measurements (BMI, weight, height, etc.), those of their parents and the nature of their relationship. The measurements of height and weight in the HSE are validated by a nurse, thus overcoming the problem of measurement error of these values present in other

11

surveys containing children, i.e. Phipps et al. (2004) or Anderson et al. (2003).

Insert Table 1 here

Table 1 provides our sample descriptive statistics including the rates of overweight and obesity for children and their parents. We report the statistics for the overall sample (13,836 observations), and segregated by type of household, i.e. those in which both parents are biological (13,536 observations) and those in which both parents are adoptive (300 observations). In the last column we show the outcome of the t-Tests analyzing if the means of the two groups are significantly different.

Looking at these statistics and the results of the T-tests, we observe that only for nine out of forty-eight variables is the difference between the groups statistically different at the 99% level and for five variables the difference is significant at the 90% level. In the light of this, we are confident that the baseline characteristics of our biological and adopted household are not strikingly different. We do observe nevertheless that adopted children in the sample are slightly older than those in a biological parents' household; they are slightly more likely to have an obese mother, an obese father, or both parents obese; their parents tend to answer the education question less often and when they do, they are less likely to be in the lower end of the education distribution.[14] Their mothers choose the 'other' occupation category more often; their parents are slightly older; they live less often in suburban areas; and, they are more often exposed to passive smoking.

The percentage of overweight children is about 23% (slightly higher for adopted but not statistically significant); of obese children 5.6%; of both

---

[14]Because there is a higher incidence of no-answer for the fathers' education, we create a NA education indicator that is included as a control.

parents being obese, 7% for the biological parents' households and 10% for the adoptive; of both being overweight ,about 40% for the former type of household and 47% for the latter. Only the mother being obese happens in about 16% of our sample; only the father being obese in 15% of the first type of households and in 17% of the second type (but again the difference is not statistically significant); only the mother being overweight in about 13% of the biological parents' families and in 11% of the adoptive families. Lastly, only the father is overweight in about 30% of both types of households. These univariate differences in the percentage of obese and overweight parents could be due to the slightly higher age of adoptive parents. We refer to the table for further details on the exact figures for the forty-eight variables. Finally, it should be noted that unlike BMI in adults, BMI among children changes over time and hence fixed thresholds can provide misleading findings. Hence, for the children we use the international standard BMI cut off points for age and sex published by the International Obesity Task Force (IOTF) as in Saxena et al. (2004). For parents, we used the standard overweight and obesity BMI cut-offs: parents are classified as overweight if their BMI is between 25 and 30 and as obese if it is greater than 30.

4   Results

Results are presented in Tables 2, 3,4 and 5. Table 2 reports the linear probability model (OLS) estimates of the effect of different measures of parental overweight interacted with an indicator variable for the child being adopted on the different measures of child's overweight. Table 3, shows the estimates of the transmission of the both parents being overweight on the likelihood of the child being overweight. The dependent variable is indicated in the top

row and whether the parents are overweight is indicated in the second row. The third row in this table indicates which type of household the child is living in (both parents biological or both parents adoptive). The method used to estimate these coefficients is a probit model and expressed as marginal effects. Table 4 re-estimates the coefficients in Table 3 by correcting the sample selection potential biases of belonging to each type of household using Heckprobit models. Finally, Table 5 is an extension of all preceding tables in which the effect of the parents' weight on that of their children is estimated controlling for the fact that the mother works full time.

Insert Table 2 here

The simple linear probability model (OLS) estimates in Table 2 suggest that both parents being overweight (obese) has a positive and significant effect on the probability of the child being overweight (obese) and that the coefficient magnitude more than doubles the effect of only the mother or only the father being overweight (obese). The sign of the indicator variable of the child being adopted is generally as expected negative but only significant when only the mother is obese and when the father is overweight or obese on the likelihood of the child being overweight. A post estimation test confirms that the estimates between adopted and non-adopted children are significantly different. The indicator variable for the child being adopted is only found to be significant in column 2, when we estimate the effect of parental obesity on the likelihood of the child being overweight.

Insert Table 3 here

The results in the first two columns of Table 3 indicate that the transmission overweight from parents to children is significant and positive when both parents are overweight for both groups of families. The increase of the likelihood of being overweight of those children when both parents are biological

14

is 0.270, and for those adopted 0.210. Again, a post estimation test is performed to confirm that the coefficients for the adoptee and the biological samples are statically different from each other. Given that the biological-parents coefficient is picking up both genetic and cultural transmission, whereas the adoptive-parents coefficient only reflects cultural transmission, this suggests that the relative importance of the cultural transmission when both parents are overweight is large. Only the mother being overweight increases significantly the likelihood of the offspring being overweight by 0.129 only for children living with both biological parents, but not for the adopted group. Only the father being overweight is significant both for families where both parents are biological (0.116) and for those where they are adoptive (0.240). The difference between these two coefficients suggests that, when only the father is overweight, the cultural transmission for adopted children is more important than both the genetic and cultural transmission for natural children.

In the second panel we report the estimates of the effect of the parents being obese on the probability of the children being overweight. For those with both biological parents, both parents being obese increases the likelihood of the children being overweight by 0.342; only the mother being obese by 0.176; and only the father being obese increases it by 0.144. For those families in which both parents are adoptive, the only significant coefficient is that of both parents being obese and its effect on the probability of the child being overweight is 0.216. The cultural intergenerational transmission of obese parents to overweight children thus seems weaker than of overweight parents to overweight children, but when both adoptive parents are obese, it is still very sizable.

Finally, the third panel in Table 3 looks at the relationship between the

obesity of the parents on the probability of the children being obese. For this case, for the first type of families (both biological), if both natural parents are obese, the likelihood of the child being obese as well increases by 0.170, when only the mother is obese, it increases by 0.070 and when only the father is obese by 0.044. For the adoptive families, if both parents are obese, the likelihood of the child being obese goes up by 0.208 but the effects of the only the mother or only the father being obese are not significant probably due to the small sample size. So again there appears to be cultural transmission of obesity, but less strongly than for overweight and, again, it is significant only when both parents are obese.

Insert Table 4 here

Table 4 corrects the estimates in Table 3 by sample selection using two-stage Heckprobit models. Results in Table 4 are comparable to those in Table 3 but a few remarks are to be made:

First, in the Table 4, the estimates of the effects of both parents being overweight on the likelihood of the child being overweight are higher than when not correcting for sample selection for those households where both parents are adoptive (above 0.246 instead of 0.210 in Table 3), and slightly smaller for those living with their biological parents (0.252 instead of 0.270). The effects of only the mother being overweight are close in magnitude to those in Table 3 but not significant for adopted children when we correct for the sample selection using the heckprobit specification (in Column 2). Thus, in sum, the bias due to sample selection of the adoptive households does not appear to be large for the overweight estimates judging by the similar estimates in the first panel in Table 4.

Second, in the second panel corresponding to the influence of obese parents on the likelihood of the child being overweight, we observe that the

16

sample selection correction decreases all coefficients for the biological parents' households and also for adoptive children, for which again, only the estimate for both parents being obese is significant.

Third, by looking at the third panel, we observe that sample selection correction reduces slightly the effect of the transmission of obesity from parents to children for children living with their biological parents. Using the Heckprobit correction model reduces by almost a tenth the effect of both adoptive parents being obese on the probability of the adopted children being obese (0.027 instead of 0.208).

The father only being overweight is not significantly associated to the likelihood of adopted children being obese (in Columns 4 and 6), similarly what we found in Table 3. The mother only being overweight or obese is not significant for any of the results involving adopted children in Columns (2), (4) and (5).

Insert Table 5 here

The results in Table 5 also test whether the fact that the mother works full time has an impact on the overweight transmission estimates. To do so, we estimate the specifications in Table 3 allowing for an interaction of an indicator variable of the mother working full time with the overweight/obesity status of the parents. We test the main effect of the combined interactions and we find a significant effect consistent with previous specifications. As can be observed from the table, none of the interactions are significant except for that with the obesity status of the father only in the second and third panel and only for the biological parents' type of families. Thus, when only the father is obese and at the same time the mother works full time the likelihoods of both the child being overweight (0.047) and being obese (0.020) increases significantly beyond the sole effect of the father being obese. But,

17

probably due to sample size issues arising from the interaction terms, some of the coefficients that were significant in previous specifications for adopted children are insignificant when using this specification.

5   Discussion

Overweight is an expression of both genetic and cultural influences. In this paper we have attempted to estimate the cultural transmission of overweight. We contribute to the literature of intergenerational transmission of health, by quantifying the strength of the intergenerational correlation of overweight in both natural children and adoptees. The analysis is conducted making use of a uniquely constructed dataset of English adoptees from 1997 to 2010. We have examined intergenerational transmission alongside a long list of other confounding variables that could be driving the association such as education, parental and child age, gender effect and, following the literature, the effect of female labour market participation.

We base our empirical approach on a theoretical model of health production by which children's overweight depends on the overweight or obese status of their parents, and thus implicitly on the parents' lifestyle choices and net caloric intakes. We follow an empirical strategy that has taken selection issues in consideration alongside drawing upon a naïve probit model. We estimate our empirical models of overweight for two types of children, those living with both their natural parents and those living with adoptive parents. We use various specifications, which include the observable characteristics of the child and the parents.

Our results indicate quite strongly that there seems to be a powerful cultural transmission of *overweight* inter-generationally, in addition to that

resulting from the genetic links even when we control for sample selection employing two different strategies using observables. For *obesity*, the results are less strong, but both parents being obese or the father alone being obese, increase the probability of observing an overweight and/or an obese child even when they are not genetically related. However, the mother alone being obese is an insignificant factor.

These findings are robust to different specifications, including the mother working full time and income, which has been pointed out as the culprit for child's obesity (Anderson, 2003). We do not find evidence that the mother works full time explains children's obesity, nor their tendency to be overweight once parental obesity is accounted for. We control for education of both parents, type of dwelling, various characteristics of the household, and degree of urbanisation. Our findings survive the inclusion and exclusion of these controls.

There is an intriguing aspect to these results. In general, the results concerning the powerful cultural transmission effect are much stronger for overweight than obesity. If both adoptive parents are overweight, or if only the father is overweight, and when we control for the mother full time, this increases the probability of the children being overweight by about 21 to 24 percentual points. However, if both adoptive parents are obese, this has no significant effect on children's likelihood of being obese. This suggests that the primary mechanism of the intergenerational transmission of obesity is much more likely to be genetic than that for overweight. Indeed, we can find little evidence from our results of any important cultural transmission of obesity.

The importance of the cultural transmission of overweight may be emphasized by the fact that some of the specifications suggest that natural parents

would have a far smaller cultural impact on their children being overweight than adoptive parents do. The latter can be the result of their being more likely to follow a different lifestyle pathway unrelated to biological triggers of behaviour.

Another thought-provoking feature of the results concerns a difference in the impact of the non-natural mother's and father's overweight. In some of the specifications the mother's overweight is not significant while the father's is. A possible explanation is that the mother is in charge of the nutrition of the children and their father and may tend to overfeed them while underfeeding or feeding adequately herself.

6 Conclusions

This paper has drawn upon a uniquely constructed dataset of English adoptees to investigate the existence and mechanisms of intergeneration transmission of overweight. We have found that that children's overweight is robustly related to the overweight of the parents, even when there is not genetic transmission as is the case of adoptees. However, while we can establish there is a strong cultural transmission of overweight, our evidence is weaker for obesity.

We also find that the cultural transmission of overweight or obesity from parents to children is not aggravated by having a full-time working mother. Nevertheless, for natural children only, having a full-time working mother does significantly increase the positive effect of having an obese father on the likelihood of the child being overweight or obese.

We acknowledge that our estimates are subject to several limitations imposed by the nature of the data. First, adopted children might belong to a

healthier/unhealthier sample than the biological, although a wealth of studies suggest that selective placement of adoptees does not seem to have an impact on the cultural transmission of health (Wilcox-Gok, 1983) and thus on health itself. Second, although adopted children are not genetically related to their parents, adoption agencies do attempt to match biological and adoptive parents in various ways (selective placements), a factor that could cause additional sources of sample selection. Third, we cannot observe the age of adoption (though the majority of adoptions takes place before the age of 3) and, hence, we cannot control for the length of a child's exposure to his/her adoptive family environment. Fourth, unlike the data obtained from adoption registers, we do not have information on the biological parents of the adoptees, and whether the children were foreign born or not. To address some of the non-randomness issues, we have compared the two types of households to ensure they are not significantly too different and still correct for sample selection biases using two-stage Heckman models. We have also run robustness checks using different specifications. Finally, the sample of obese adopted children is small, and the number of those who have obese parents even smaller. This hinders the strength of our results regarding the cultural transmission of obesity from parents to children.

Our paper improves upon existing literature by using the Health Survey for England to examine a sample of children living in homes where parents are either both adoptive or both biological. The advantage of this dataset is that it contains the same data on adopted and biological children and their living-in parents, including anthropometric measurements and parents', children's and household's characteristics. Thus, unlike data on adoptees from administrative records, we do not need to match the sample of children with the general population.

A comparison of our findings with that of the wider literature on inter-generation transmission for education (Holmlund et al, 2011) reveals that for obesity genes play a larger role than for overweight, which is quite sensitive to changes in the environment. This is consistent with health conditions such as asthma, allergies, headaches and diabetes (Thomson, 2014) and other studies that do not disentangle total from cultural transmission (Classen and Hokayem 2005, Classen, 2010 and Costa-Font and Gil, 2013).

We conclude that this paper provides evidence in favour of the hypothesis that there is a strong cultural component in the transmission of cultural habits that promote overweight from parents to children. That is, gender specific effects might still reflect that, as some studies show (Lake et al., 2006), food responsibility was predominately a female dominated, but the ingest of such food might be more that proportionally consumed by men and children. The importance of both parents being overweight in explaining the overweight of the children might as well reflect evidence of assortative mating, or alternatively a reinforcing environmental effect that takes place when both parents adopt similar behaviours. One hypothesis consistent with assortative mating is that health and lifestyle preferences end up determining partner-matching. Thus, both parents may be overweight or obese as a result of sharing a common lifestyle and tastes, which are in turn passed on to their children. Our results suggest that that there is room to design policies to tackle children's overweight and obesity by influencing parental overweight and their lifestyles, and that ideally both parents should be influenced for the effect to be more effective; otherwise problems of children overweight are likely to persist. Overweight is passed through generations, and the pathway seems to be primarily driven by the children environment. In contrast, and consistently with the behavioural generics literature, obesity exhibits a

highly genetic component. The latter does not imply that policy intervention will not be effective, but that effective interventions need to expand beyond changes in environmental drivers of the condition.

7   References

Ahlburg, D., 1998. Intergenerational transmission of health. The American Economic Review Papers and Proceedings 88 (2), 265–270.

Anderson, P, Butcher, K and Levine, P (2003). Maternal Employment and Overweight Children. Journal of Health Economics, 22(3): 477-504.

Anderson, P., Butcher, K., Schanzenbach, D. (2007). Childhood disadvantage and obesity: is nature trumping nurture? NBER Working Paper No. 13479.

Anderson, PM and Butcher, KF (2006). Childhood obesity: trends and potential causes. The Future of Children, 16(1): 19-45.

Amelia A. Lake, Robert M. Hyland, John C. Mathers, Andrew J. Rugg-Gunn, Charlotte E. Wood, Ashley J. Adamson, (2006) "Food shopping and preparation among the 30-somethings: whose job is it? (The ASH30 study)", British Food Journal, Vol. 108 Iss: 6, pp.475 – 486

Berenson, G. S., Srinivasan, S. R., Wattigney, W. A., Harsha, D. W. (1993). Obesity and Cardiovascular Risk in Childrena. Annals of the New York Academy of Sciences, 699(1), 93-103.

Bisin, A. and Verdier, T. (2001), 'The Economics of Cultural Transmission and the Dynamics of Preferences', Journal of Economic Theory 97(2), 298-319.

Bisin, A and Topa, G (2003). Empirical Models of Cultural Transmission, Journal of the European Economic Association, 1(2-3): 263-375.

Bisin, A., and T. Verdier (2000), "Beyond the Melting Pot: Cultural Transmission, Marriage, and the Evolution of Ethnic and Religious Traits," Quarterly Journal of Economics 115(3), 955-988

Björklund, A,M Lindahl, and EPlug (2006). "The Origins of Intergenerational Associations: Lessons from Swedish Adoption Data." Quarterly Journal of Economics 121:999-1028.

Björklund, Anders, and Laura Chadwick(2003). "Intergenerational Income Mobility in Female Labor Force Dynamics," Quarterly Journal of Economics, 119(4), 1249-1299.

Björklund, Anders,Markus Jäntti, and Gary Solon (2005). Influences of Nature and Nurture on Earnings Variation: A Report on a Study of Various Sibling Types in Sweden. In Samuel Bowles, Herbert Gintis, and Melissa Osborne Groves,(eds) Unequal Chances: Family Background and Economic Success. Princeton: Princeton University Press, 2005, pp. 145-164.

Case A, Fertig A, Paxson C (2003) 'From Cradle to Grave? The Lasting Impact of Childhood Health and Circumstance' NBER Working Paper 9788

Cesarini, D, Dawes, C.T ,Johanesson, M Lichtenstein, P and Wallace, B (2009a). Genetic Variation in Preferences for Giving and Risk Taking. Quarterly Journal of Economics. Quarterly Journal of Economics, 124: 809-842

Cesarini, D., Lichtenstein, P., Johannesson, M. and Wallace, B. (2009b), Heritability OfOverconfidence. Journal of the European Economic Association, 7: 617–627

Chia, Yee Fei. 2008. "Maternal labour supply and childhood obesity in Canada: evidence from the NLSCY" Canadian Journal of Economics, 41(1):217-242.

Classen, T., Hokayem, C., (2005). Childhood influences on youth obesity.

Economics and Human Biology 3(2), 165–187.

Classen, Y (2010). Measures of the intergenerational transmission of body mass index between mothers and their children in the United States, 1981–2004. Economics and Human Biology 8 30-43.

Coate, D (1983). The relationship between diet, parent's fatness and obesity in children and adolescence. NBER Working Paper, 1072.

Coate, D. (1983) The relationship between diet, parent's fatness, and obesity in children and adolescents, NBER Working Paper No, 1072.

Coneus, K and Spiess, CK (2011). Intergenerational Transmission of Health in Early Childhood – Evidence form the German Socio-economic Panel Study. Economics and Human Biology, 10: 89-97.

Costa-Font, Joan and Gil, Joan (2013) Intergenerational and socioeconomic gradients of child obesity Social Science and Medicine, 93. 29-37.

Currie J and Moretti E (2007) 'Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight' Journal of Labour Economics, Vol 25 No. 2, pp 231–264.

DeAgostini, P (2007). Diet Composition, Socio-Economic Status and Food Outlets Development in Britain. ISER Working Paper 2007-2009.

Duncan, Haller and Portes (1968) Peer influences on aspirations: A Reinterpretation. American Journal of Sociology 74(2):119-37.

Duncan, G, A Kalil, S E. Mayer, R Tepper, and M R. Payne (2005).The Apple Does Not Fall Far from the Tree. In Unequal Chances: Family Background and Economic Success Edited by Samuel Bowles, Herbert Gintis, Melissa Osborne Groves, Princeton University Press.

Elks CE, den HM, Zhao JH, Sharp SJ, Wareham NJ, Loos RJ, et al (2012). Variability in the heritability of body mass index: a systematic review and meta-regression. Front Endocrinol, 3:29

Emanuel I, Filakti H, Alberman E, Evans SJ.(1992) Intergenerational studies of human birthweight from the 1958 birth cohort. 1. Evidence for a multigenerational effect. Br J Obstet Gynaecol 1992;99:67–74.

Fernández, R., A. Fogli, and C. Olivetti (2004), "Mothers and Sons: Preference Formation and Permanent and Separated Families." Economics Letters 80, 239-246.

Fertig, Angela, Gerhard Glomm, and Rusty Tchernis (2009). "The connection between maternal employment and childhood obesity: inspecting the mechanisms" Review of Economics of the Household, 7:227-255

Fogelholm M, Kukkonen-Harjula K (2000). Does physical activity prevent weight gain : a systematic review. Obes Rev 2000; 1:95–111.

Goode, A., Mavromaras, K. G. and Smith, M. (2008). Intergenerational Transmission of Healthy Eating Behaviour and The Role of Household Income, IZA Discussion Paper No. 3535

Goran MI, Shewchuk R, Gower BA, Nagy TR, Carpenter WH,Johnson RK (1998). Longitudinal changes in fatness in white children effect of childhood energy expenditure. Am JClin Nutr 1998; 67: 309–316.

Greenough, W.T, Black, JE and Wallace, CS (1987). Experience and brain development, Child Development, 58: 539-59.

Grilo CM, Pogue-Geile ME. (1991). The Nature of Environmental Influences on Weight and Obesity: A Behaviour Genetic Analysis. Psychological Bulletin 110(3); 520-537.

Hamermesh, D (2010). Incentives, time use and BMI: The roles of eating, grazing and goods. Economics and Human Biology 8 , 2–15.

Hebebrand J., Wulftange H., Goerg T., Ziegler A., Hinney A., Barth N., Mayer H., Remschmidt H. (2000). Epidemic obesity: are genetic factors involved via increased rates of assortative mating? Int. J. Obes. Relat.

Metab. Disord. 24, 345–353

Heckman JJ (1979) Sample selection bias as a specification error. *Econometrica* 47, 153–161.

Hruschka, D.J and AA. Brewis (2013). Intercontinental differences in overweight of adopted Koreans in the United States and Europe', Economics and Human Biology 11 (3), 2013, pp. 345-350.

Holmlund, H, Lundhal, M and Plug, E (2011). The Causal Effect of Parents Schooling on Children's Schooling : A Comparison of Estimation Models. Journal of Economic Literature, 49 (3): 615-651. Koeppen-Schomerus, G J Wardle and R Plomin (2001). A genetic analysis of weight and overweight in 4-year-old twin pairs International Journal of Obesity (2001) 25, 838-844 Llewellyn CH, Trzaskowski M, Plomin R, Wardle J (2013). Finding the missing heritability in pediatric obesity: the contribution of genome-wide complex trait analysis. Int J Obes 37(11):1506-9.

Liu, E., Hsiao, C., Matsumoto, T., Chou, S (2009) , Maternal full-time employment and overweight children: Parametric, semi-parametric, and nonparametric assessment. Journal of Econometrics.

Maes HHM, Neale MC, Eaves LJ. (1997) Genetic and Environmental Factors in Relative Body Weight and Human Adiposity. Behavior Genetics 27(4); 325-351. Manski, C (2011). Genes, Eyeglasses, and Social Policy. Journal of Economic Perspectives, 25 (4): 83- 9. Martin, M., (2008). The intergenerational correlation in weight: how genetic resemblance reveals the social role of families. American Journal of Sociology 114, S67–S105

Martin Caraher, Paul Dixon, Tim Lang, Roy Carr-Hill, (1999) "The state of cooking in England: the relationship of cooking skills to food choice", British Food Journal, Vol. 101 Iss: 8, pp.590 - 609

Moorman, J.E., and Hernandez, D.J (1089). Married-couple families with

step, adopted, and biological children. Demography (May 1989) 26(2):267-77

OECD (2015). Obesity and the Economics of Prevention: Fit not Fat - Korea Key Facts. Organisation of Economic Cooperation and Development (http://www.oecd.org/els/health-systems/obesityandtheeconomicsofpreventionfitnotfat-koreakeyfacts.htm, accessed January 2015).

Oreopolous P, Stabile M, Walld R, Roos L 'Short, Medium, and Long Term Consequences of Poor Infant Health: An Analysis using Siblings and Twins' NBER Working Paper No. W11998.

Parsons, TJ. Parsons1, C Power1 and O Manor (2005). Physical activity, television viewing and body mass index: a cross-sectional analysis from childhood to adulthood in the 1958 British cohort. International Journal of Obesity (2005) 29, 1212–1221.

Phipps, Shelly A., Peter Burton , Lynn Lethbridge, and Lars Osberg. 2004. "Measuring Obesity in Young Children." Canadian Public Policy. 30(4):349-364.

Plomin R. (1990). The role of inheritance in behavior. Science 248, 183–188

Plug, E (2004). Estimating the Effect of Mother's Schooling on Children's Schooling Using a Sample of Adoptees." American Economic Review 940 , 358-368.

Plug, Erik. and W Vijverberg (2005). "Does Family Income Matter for Schooling Outcomes? Using Adoptees as a Natural Experiment." Economic Journal 115, 879-906

Propper C., Rigg J., Burguess S. (2007) Child health: evidence on the roles of family income and maternal mental health from a UK birth cohort. Health Economics 16(11): 1245-1269

Rosenbaum P.R., Rubin D.B., (1983) The Central Role of Propensity

Score in Observational Studies for Casual Effects, Biometrika, 70, 41–55

Rhee K.E., Phelan S., McCaffery J, (2012) 'Early Determinants of Obesity: Genetic, Epigenetic, and In Utero Influences', International Journal of Pediatrics, Vol 2012.

Sacerdote, B (2007). "How Large Are the Effects from Changes in Family Environment? A Study of Korean American Adoptees. Quarterly Journal of Economics 122, 119-157.

Saxena S., G Ambler, T J Cole, A (2004). Majeed 'Ethnic group differences in overweight and obese children and young people in England': cross sectional survey , Arch Dis Child 2004;89:30–36

Scarr, Sandra, and Richard A. Weinberg. "Educational and Occupational Achievements of Brothers and Sisters in Adoptive and Biologically Related Families." Behaviour Genetics 24 (1994), pp. 301-325.

Silventoinen K., Kaprio J., Lahelma E., Viken R. J., Rose R. J. (2003). Assortative mating by body height and BMI: Finnish twins and their spouses. Am. J. Hum. Biol. 15, 620–627.

Sorensen, T, I.A , Price, RA, Stunkard, AJ and Schulsinger, F (1989). Genetics of obesity in adult adopted and their biological siblings. BMJ, 298, 87-90.

Stunkardt, AJ, Thorkild I.A. Sørensen, Dr.med., Craig Hanis, Ph.D., Thomas W. Teasdale, M.A., Ranajit Chakraborty, Ph.D., William J. Schull, Ph.D., and Fini Schulsinger (1986). An adoption study of human obesity, NEJM, 314, 193-8.

Stunkard, AJ J R. Harris, N L. Pedersen, and GE. McClearn(1990). The Body-Mass Index of Twins Who Have Been Reared Apart. N Engl J Med 1990; 322:1483-1487

Townsend N (2009) Obesity and Overweight Surveillance in England:

what is measured and where are the gaps? Oxford: National Obesity Observatory, 2009

Thompson, O (2014). Genetic mechanisms in the intergenerational transmission of health. Journal of Health Economics, 35: 132-145.

Van de Ven, W.P. and Van Praag, B.M. (1981). The demand of deductibles in private health insurance: A probit model with sample selection, Journal of Econometrics, 17, 229-252.

Von Hinke Kessler Scholder, S (2007). Overweight Children: Does Timing Matter? CMPO working Paper, 07/180.

Wardle J., Carnell S., Haworth C.M.A, Farooqi I.S., O'Rahilly S., and Plomin R. (2008), "Obesity associated genetic variation in FTO is associated with diminished satiety," Journal of Clinical Endocrinology and Metabolism, vol. 93, no. 9, pp. 3640–3643.

Whitaker, R., Wright, J., Pepe, M., Seidel, K., Dietz, W., (1997). Predicting obesity in young adulthood from childhood and parental obesity. The New England Journal of Medicine 337 (13), 869–873

WHO (1999). Definition, diagnosis and classification of diabetes mellitus and its complications: Report of the WHO consultation. Geneva, World Health Organization (WHO), 1999.

Wickrama, KAS Rand D. Conger, Lora Ebert Wallace, Glen H. Elder, Jr (1999). The Intergenerational Transmission of Health-Risk Behaviours: Adolescent Lifestyles and Gender Moderating Effects. Journal of Health and Social Behaviour, 40(3): 258-272.

Wilcox-Gok, V (1983). The Determination of Child Health: An Application of Sibling and Adoption Data. Review of Economics and Statistics, 65(2): 266-73

Table 1: Summary Statistics and T-test statistics

		Overall Sample	A Natural	B Adopted	Sign Diff B-A
	Number of Observations	13836	13536	300	
Child	Obese Child	5.7%	5.7%	5.7%	
	Overweight Child	23.5%	23.5%	25.3%	
	Age of Child	9.1	9.0	10.9	***
	Female	49.1%	49.2%	46.3%	
	White	78.7%	78.6%	79.3%	
	Black (Caribbean, African or Other)	4.4%	4.4%	5.0%	
	South East Asian and Other	12.7%	12.7%	15.0%	
	Pakistan/Bangladesh/Chinese	4.2%	4.3%	0.7%	
Parents' Obesity	Obese Mother	21.1%	21.0%	26.0%	*
	Obese Father	22.4%	22.3%	27.3%	*
	Overweight Mother	13.0%	13.0%	11.3%	
	Overweight Father	31.7%	31.7%	29.3%	
	Both parents Obese	7.0%	6.9%	10.0%	*
	Only Mother Obese	14.1%	14.1%	16.0%	
	Only Father Obese	15.4%	15.4%	17.3%	
	Both parents Overweight	39.9%	39.7%	46.7%	*
	Only Mother overweight	13.0%	13.0%	11.3%	
	Only Father Overweight	31.7%	31.7%	29.3%	
Parents' Characteristics	Mum Education: NA	13.1%	13.1%	15.3%	
	Mum Education: HE	31.2%	31.2%	32.3%	
	Mum Education: A/O Level	47.8%	47.8%	45.7%	
	Mum Education: CSE	5.9%	5.9%	5.3%	
	Mum Education Foreign	2.0%	2.0%	1.3%	
	Dad Education: NA	15.0%	14.8%	20.3%	***
	Dad Education: HE	41.3%	41.5%	32.7%	***
	Dad Education: A/O Level	37.2%	37.1%	39.0%	
	Dad Education: CSE	5.4%	5.4%	5.7%	
	Dad Education Foreign	1.1%	1.1%	2.3%	
	Mother at home	26.1%	26.2%	23.7%	
	Mother Employed	69.8%	69.8%	68.3%	
	Mother Retired	0.1%	0.1%	0.0%	
	Mother Other	4.1%	4.0%	8.0%	***
	Dad at home	1.3%	1.3%	2.0%	
	Dad Employed	90.4%	90.4%	88.3%	
	Dad Retired	0.7%	0.7%	1.7%	
	Dad Other	7.6%	7.6%	8.0%	
	Mother's Age	38.3	38.3	41.1	***
	Father's Age	41.0	40.9	43.8	***
Other Household Characterstics	Income	£ 30,899.11	£ 30,913.34	£ 30,257.37	
	Own Flat	82.7%	82.7%	84.0%	
	Small Family	44%	45%	13%	
	Large Family	28%	27.6%	43.3%	***
	Large Adult Family	12%	12.3%	18.7%	***
	Urban	11%	11%	24%	
	Suburban	44%	44.5%	38.0%	*
	Rural	22%	22.0%	24.0%	
	Passive Smoking in household	22.9%	22.7%	31.3%	***

Notes: This table provides the summary statistics of the variables used in our. Column one displays the statistics for the overall sample, column two for households in which both parents are natural, column three for families with adoptive parents, and, finally, column four indicates the level of significance of the difference in means between households with natural parents and those with adoptive parents. The vertical panels shows first variables reflecting the characteristics of the child including overweight; second the parental overweight; third parental characteristics; and finally, other household characteristics. The level of significance of the t-test are indicated by the number of stars: * p<0.05 ** p<0.0*** p<0.001.

Table 2: OLS regression with interaction effects

	(1)	(2)	(3)
Dependent variables: Child is	Overweight (including obese)	Overweight (including obese)	Obese
Control for parents being:	Overweight	Obese	Obese
Both parents	0.2280***	0.3049***	0.1386***
	-0.0095	-0.0172	-0.0124
Both * Adopted	-0.0522	-0.1605	0.0479
	-0.0602	-0.1013	-0.0785
Only Mum	0.0868***	0.1540***	0.0553***
	-0.0116	-0.0116	-0.0067
Mum * Adopted	-0.0077	-0.1829**	-0.0907***
	-0.0833	-0.0716	-0.0163
Only Dad	0.0762***	0.1209***	0.0323***
	-0.009	-0.0108	-0.0055
Dad * Adopted	-0.1194*	-0.1319*	0.0075
	-0.0685	-0.0732	-0.0476
Adopted	-0.007	0.0691**	0.0024
	-0.0446	-0.0344	-0.0146
Girl	0.0487***	0.0497***	0.0175***
	-0.0067	-0.0067	-0.0036
Observations	13836	13836	13836
F-Test	33.32	29.25	17.3
R-squared	0.05	0.054	0.035

Notes: This table reports the estimates of the Ordinary Least Squares models estimating the effect on the likelihood of a child being overweight of measures of parental overweight interacted with a control variable for the child being adopted. The rows identify the effect of both parents being overweight, only the mum being overweight or only the father being overweight. Given that gender might exert a specific effect, we include the effect of the child being a girl. The first column shows the effect of parental overweight on likelihood of the child being overweight. In the second column we examine the effect of parental obesity on child overweight. Finally, the last column estimates the effect of parental obesity on child obesity. The models control also for ethnicity, parents' education, passive smoking, flat ownership, income and include time and regional fixed effects. We provide robust standard errors in brackets.

Table 2: Probit Model of the influence of parents being overweight/obese on the likelihood of child being obese/overweight*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent var: Child is	Overweight (including obese)		Overweight (including obese)		Obese	
Control for parents being*:	Overweight		Obese		Obese	
Type of Household	Both parents biological	Both parents Adoptive	Both parents biological	Both parents Adoptive	Both parents biological	Both parents Adoptive
Both	0.270***	0.210**	0.342***	0.216*	0.170***	0.208**
	(0.014)	(0.086)	(0.019)	(0.129)	(0.016)	(0.100)
Mum Only	0.129***	0.102	0.176***	-0.007	0.070***	
	(0.019)	(0.124)	(0.013)	(0.068)	(0.009)	
Dad Only	0.116***	0.240**	0.144***	0.011	0.044***	0.025
	(0.015)	(0.104)	(0.013)	(0.068)	(0.007)	(0.026)
Female	0.047***	0.036	0.048***	0.046	0.016***	0.003
	(0.007)	(0.047)	(0.007)	(0.051)	(0.004)	(0.010)
Observations	13836	13836	13836	13836	13836	13836
Log Likelihood	-6995.728	-157.207	-6995.551	-158.557	-2761.131	-48.932

Notes: This table reports the estimates of the probit models estimating the effect of measures of parental overweight on the likelihood of a child being overweight based on BMI. The rows identify the effect of both parents being overweight, only the mum being overweight or only the father being overweight. Given that gender might exert a specific effect, we include the effect of the child being a girl. The first column shows the effect of parental overweight on likelihood of the child being overweight when both parents are natural. The second column estimates the same for the sample of households when both parents are adoptive. In the third and fourth columns, we examine the effect for both household samples of parental obesity on child overweight. Finally, the last two columns estimate the effect of parental obesity on child obesity. Due to the reduced sample size, the last column does not produce estimates for the mother being obese. All estimates are marginal effects. The models control also for ethnicity, parents' education, passive smoking, flat ownership, income and include time and regional fixed effects. We provide robust standard errors in brackets.

Table 4: Models of the influence of parents overweight/obese on child obese/overweight correcting from sample selection bias of type of household*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent var: Child is	Overweight (including obese)		Overweight (including obese)		Obese	
Control for parents being:	Overweight		Obese		Obese	
Type of Household	Both parents biological	Both parents Adoptive	Both parents biological	Both parents Adoptive	Both parents biological	Both parents Adoptive
Both	0.252***	0.246**	0.277***	0.148**	0.102***	0.027***
	(0.015)	(0.086)	(0.016)	(0.119)	(0.011)	(0.123)
Mother	0.115***	0.157	0.154***	-0.014	0.058***	-0.188
	(0.016)	(0.129)	(0.011)	(0.063)	(0.008)	(0.811)
Father	0.109***	0.272***	0.129***	-0.001	0.039***	0.008
	(0.014)	(0.100)	(0.011)	(0.061)	(0.007)	(0.039)
Female	0.046***	0.046	0.047***	0.038	0.017***	0.002
	(0.007)	(0.057)	(0.007)	(0.055)	(0.004)	(0.012)
Observations	13836	13836	13836	13836	13836	13836
Log Likelihood	-1.27e+04	-1574.124	-1.27e+04	-1575.787	-8451.805	-1456.645

Notes: In this table we report the estimates of the effect of parental overweight on the likelihood of a child being overweight (based on BMI) controlling for sample selection bias using a Heckprobit specification. As in Table 3, we present the estimates of the indicator variables identifying both parents being overweight/obese, only the mum being overweight/obese or only the father being overweight/obese. Again, we include the effect of the child being a girl. The first and second column show the effect of parental overweight on likelihood of the child being overweight: Column 1 when both parents are natural. Column 2 when we correct for the selection sample using a heckprobit specification. The third and fourth columns show the corresponding estimates when parents are obese on the likelihood of the child being overweight. The last two columns show the estimates of the effect of parental obesity on child obesity. All estimates are marginal effects. The models control also for ethnicity, parents' education, passive smoking, flat ownership, and income and include time and regional fixed effects. In the Heckprobit selection equation, we include parents' age, the father being unemployed or working full-time, mother's qualifications, type of household, and living in an urban area. We provide robust standard errors in brackets.

Table 3: Probit Models controlling for mother working full time

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent var: Child is	Overweight (including obese)		Overweight (including obese)		Obese	
Control for parents being:	Overweight		Obese		Obese	
Type of Household	Both parents biological	Both parents Adoptive	Both parents biological	Both parents Adoptive	Both parents biological	Both parents Adoptive
Both	0.273***	0.212***	0.325***	0.240*	0.150***	0.124
	(0.017)	(0.064)	(0.032)	(0.140)	(0.025)	(0.101)
Both*(mother work FT=1)	-0.005	-0.003	0.019	-0.030	0.012	0.036
	(0.013)	(0.073)	(0.031)	(0.128)	(0.013)	(0.061)
Mother	0.116***	0.047	0.194***	-0.087	0.065***	
	(0.026)	(0.154)	(0.021)	(0.129)	(0.013)	
Mother (mother work FT=1)	0.017	0.082	-0.022	0.121	0.004	
	(0.024)	(0.177)	(0.019)	(0.211)	(0.010)	
Dad	0.124***	0.241**	0.106***	-0.029	0.026**	0.009
	(0.019)	(0.107)	(0.022)	(0.084)	(0.011)	(0.029)
Dad*(mother work FT=1)	-0.011	-0.001	0.047**	0.071	0.020*	0.020
	(0.016)	(0.087)	(0.023)	(0.136)	(0.012)	(0.049)
Female	0.047***	0.035	0.048***	0.047	0.016***	0.004
	(0.007)	(0.045)	(0.007)	(0.047)	(0.004)	(0.010)
Observations	13528	300	13528	300	13528	238
Log Likelihood	-6995.026	-157.080	-6991.820	-158.157	-2758.701	-48.441

Notes: This table reports the estimates of the probit models estimating the effect of measures of parental overweight on the likelihood of a child being overweight (based on BMI) examining if the mother working full time compounds the effect of parental overweight. The rows identify the effect of both parents being overweight, only the mum being overweight or only the father being overweight. The extra rows below each of these indicators include interactions with the mother working full time. As in Table 3, the first column shows the effect of parental overweight on likelihood of the child being overweight when both parents are natural. The second column estimates the same for the sample of households when both parents are adoptive. In the third and fourth columns, we examine the effect for both household samples of parental obesity on child overweight. Finally, the last two columns estimate the effect of parental obesity on child obesity. Due to the reduced sample size, the last column does not produce estimates for the mother being obese. All estimates are marginal effects. The models control also for ethnicity, parents' education, passive smoking, flat ownership, and income. We provide robust standard errors in brackets. Missing effect of mother effect on obesity results from no observation in the sample.