Intergenerational Transmission of the Body Mass Index (BMI) in Children and Adolescents: A Panel Study for Mexico.

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Abstract

Child obesity in Mexico has reached alarming levels in the last few years. In this paper we use data from the Mexican Family Life Survey (MxFLS) to study the parental transmission of a measure usually employed in the identification of overweight and obesity: the Body Mass Index (BMI). We find a strong correlation between the BMI of fathers and children, which seems to hold even after controlling for genetic predispositions and time-invariant habits. This father-child relationship tends to be stronger for families with a high socioeconomic status and for households with a small number of members. Regarding the maternal transmission of BMI we find that it is strong and highly significant under an OLS approach, but it is not robust to the inclusion of household or individual fixed effects. Also, children of working mothers tend to experience a higher level of maternal transmission, with respect to children whose mothers do not work. In general, both parental transmission coefficients seem to increase with the child's age, however the marginal effect of age is not constant across the age distribution. There is also slight evidence of a role modelling process in which children tend to experience a higher transmission from the parent of the same sex. Finally, we find that obese and overweight parents are more prone to transmit their anthropometric status relative to normal weight parents, which suggests the presence of an intergenerational reinforcement process enhancing obesity among children and adolescents.

Contents

1. Introduction

Health is an important topic in economics, not only because it represents an essential component of overall human wellbeing but also because it has particular implications that reinforce the socioeconomic status of the individuals. For children, this relationship becomes more complex since there are multiple mechanisms through which health conditions might be reflected in future socioeconomic status. According to evidence compiled by Currie and Vogl (2012), healthy children are more likely to become healthy and wealthy adults. Given the importance of early-life health outcomes on the determination of future socioeconomic status and welfare, it becomes essential to identify the main factors influencing children's health.

One of these factors has to do with the concept of intergenerational transmission which refers to those influences that the child receives from their parents and have an effect on their health. The child's health situation is usually a function of a set of genetic and environmental characteristics that are shared between parents and children. While some parents may transmit healthy genes to their children, others might be passing on defective genes that contain a predisposition for certain illnesses. Similarly, some parents might transmit health-enhancing behaviors whilst others (advisedly or not) may be teaching unhealthy habits to their children that could have repercussions on their health and wellbeing. Since children cannot control what kind of parents they get, having a high level of intergenerational transmission for health outcomes suggests that a child's potential to be healthy in the present and become a healthy adult in the future is not the same for all individuals, which may have adverse consequences in terms of economic equality and social mobility (Dolton and Xiao, 2014). That is, if the intergenerational transmission of health is sufficiently strong there may be a group of people that are condemned to have poor health across generations. Consequently, the analysis of the intergenerational transmission of health outcomes becomes essential in order to design better and more effective public policies that take into account these potential disparities among individuals.

In Mexico, most of the problems in terms of child health have to do with nutritional deficiencies, usually associated with conditions such as underweight, overweight and obesity. Although some policies have been designed to fight these problems (especially overweight and obesity), most of them rely on the external influences that the child might be receiving from outside the household, such as the availability of junk food at school (via legal prohibitions and required standards for the food that is sold there). However, given the intergenerational nature of genetic predispositions and family habits, it is quite possible that a great part of a child's obesity problem could be explained by influences provided within the household, specifically by the parents. Although there are a few studies documenting the relationship between the anthropometric situation of parents and children in Mexico, none of them has considered the calculation of actual transmission coefficients for both parents taking into account the presence of genetic, socioeconomic and behavioral influences. One of the most relevant studies in this matter is the one by Rodriguez-Oreggia and Perez (2010), in which the authors conclude that having obese individuals as family members makes people more likely to be obese as well. However, their estimation involves a mix of mechanisms happening inside the household and it's hard to tell how much of it is due to parental transmission and how much can be explained by the influence of siblings and other relatives. In this study it is our main objective to estimate transmission coefficients that quantify how much of a child's anthropometric condition can be explained by the one of the parents, so that we know how much can a child's condition be modified by deliberately altering the parents' information and behavior. Dolton and Xiao (2014) calculate a mother-child elasticity of transmission using data from Urban households in Mexico, however their sample is not representative of the whole population (it considers only urban households) and their estimation of the mother-child elasticity might be slightly biased due to omission of the father's anthropometric information in the analysis.

In this paper we use panel data from the Mexican Family Life Survey (MxFLS) in the periods 2002, 2005-2006 and 2009-2012 to study the intergenerational transmission of an anthropometric measure usually associated with the identification of health problems such as underweight and obesity: the Body Mass Index (BMI). Using longitudinal data from parents and their offspring (children and adolescents between 0 and 19 years old) we measure the coefficients of parental transmission of BMI. Additionally, we use interaction variables to find out whether the strength of the parental transmission varies according to the child's age and gender, as well as across the distribution of the household socioeconomic status and the parents' anthropometric situation.

This study finds a strong positive correlation between the BMI of parents and children, nevertheless only the paternal link is resistant to the consideration of household and individual fixed-effects. In terms of the size of the parental transmission, we notice that children tend to experience a higher degree of BMI transmission from the parent of the same sex, which might be due to the presence of a role modelling process. Regarding the effect of age, we find that as children grow up their BMI z-scores resemble the ones of their parents in a more noticeable way, however this positive marginal effect is not constant across the distribution of the child's age. As regards the effect of the family's socioeconomic status, we find that the father-child link in BMI tends to be particularly stronger for those households in the higher tail of the income distribution and for children whose fathers work as patrons, employers or business owners. Similarly, children of working mothers tend to experience a higher degree of maternal transmission in comparison with children of mothers who do not work; however this effect is not statistically significant. Additionally, we notice that the strength of the father-child link seems to weaken as the household grows in size, suggesting that the marginal effect of the father´s influence on the child´s BMI decreases as the child has additional behavioral and environmental influences inside the household. Finally, we find that both parental correlations tend to be higher for children whose parents are obese and overweight, and this effect is especially significant for the father-child relationship.

Next subsection presents a brief description of the nutritional status of children in Mexico and the importance of child obesity as a public health issue. In subsection 1.2 we present a literature review on the process of intergenerational transmission and their applications on health outcomes and subsection 1.3 explains the objectives of this paper as well as our contribution to the literature. Section 2 describes our data source (the Mexican Family Life Survey) as well as some summary statistics for the main variables in our study. Section 3 explains some methodological details, the model used, as well as our estimation strategy. We discuss the results of our research in section 4. Finally, conclusions are presented in section 5.

1.1. The nutritional status of children in Mexico.

Most of the threats to child health in Mexico are related to nutritional deficiencies, which are usually associated with two fundamental problems: malnutrition and obesity. In spite of the great advances the country has achieved against these problems in the last few years the figures are still worrying.

Malnutrition is the name of a condition in which a person lacks the consumption or bioavailability of energy and nutrients that are needed by the organism in order to function properly. When individuals constantly lack the nutrients they need and this situation becomes chronical, their nutritional deficiencies are inevitably reflected in their weight, and in the case of children, also in their height. The consequences of being malnourished and underweight go beyond mere physical weakness and may become severe in some cases as this nutritional disorder usually makes the body vulnerable to other kind of health threats. Actually, according to Rodriguez (2011), the problem of malnutrition in Mexico is not a mechanic effect of the scarce availability of food in the household, but it develops as a consequence of a complex vicious cycle of lack of essential health care, frequent bacterial infections, nutrimental disequilibrium, decrease in the immunological resistance, infections mismanagement, vomit and anorexia, recurrent malnutrition and even longer infection episodes.

In 2012, more than a million children under 5 years old had low height for their age, and more than 300,000 had low weight, representing around 14 and 3 percent of the Mexican preschooler population, respectively[1]. Although the incidence of these problems is still considerable, there has been a significant improvement over the last decades. For example, the proportion of underweight children under 5 years old has been reduced from 9.6 to 2.8 percent between 1988 and 2013, and according to the International Food Policy Research Institute (IFPRI) Mexico is nowadays out of the top 100 countries with higher prevalence of this problem[2]. Likewise, the incidence of low height among children under 5 years old has decreased from 26.9 to 13.6 percent in the period from 1988 to 2012, which represents a reduction of almost 50 percent.

[1] Encuesta Nacional de Salud y Nutrición, 2012. Resultados Nacionales. Secretaría de Salud, México, 2012.
[2] 2014 Global Hunger Index Data. International Food Policy Research Institute (IFPRI).

The other side of the coin in terms of nutritional deficiencies affecting Mexican children is obesity, which refers to an excess of body fat. According to the World Health Organization (WHO) the essential origin of this problem is a disequilibrium between the calorie intake and the amount of calories expended, which is generally the consequence of an increased consumption of high-calorie meals rich in fat and a decreased physical activity due to sedentary lifestyles[3]. Just as malnutrition, overweight and obesity also tend to have long-term negative consequences since those individuals affected by these problems are usually more prone to suffer from diabetes, hypertension, heart diseases, osteoarthritis and even cancer.

In Mexico, child obesity has reached alarming levels in the last few years. Actually, the statistics for this problem are so high that the country has been recently ranked sixth in child obesity just after Greece, Italy, New Zealand, Slovenia and the United States[4]. According to the OECD's Obesity Update 2014, in Mexico 28 percent of male children between 5 and 17 years old suffer from overweight or obesity, while this figure goes up to 29 percent for female children. The gravity of this problem is accentuated when we consider that, unlike malnutrition and underweight, the prevalence of overweight and obesity in Mexican children has been increasing in the last few years. In this regard, data from the ENSANUT 2012 reveals that the proportion of children under 5 years old suffering from these problems has gone from 7.8 percent in 1988 to 9.7 percent in 2012. In the same year, more than 1 in 5 adolescents between 12 and 19 years old had overweight and 1 in 10 suffered from obesity, the prevalence of these problems in adolescents having increased almost trice from 1988 to 2012.

Considering that a significant proportion of these overweight and obese children and adolescents are likely to become overweight and obese adults, this problem is also a matter of concern for policymakers, who need to ideate a system of social security with the capacity to support an upcoming group of young adults suffering from diseases that used to affect old people only. Actually, Mexican government has recently recognized the fact that the country is going through a transition process in which obesity and overweight have unusually increased, affecting all sectors of the population independently of their

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[3] Obesity and overweight. Fact sheet No. 311. World Health Organization (WHO) http://www.who.int/mediacentre/factsheets/fs311/en/.

[4]Obesity update, 2014. Organization for Economic Co-operation and Development (OECD). http://www.oecd.org/els/health-systems/Obesity-Update-2014.pdf

age, geographical location or whether they live in rural or urban zones. In response to this phenomenon, in 2013 the government implemented the National Strategy for the Prevention and Control of Overweight, Obesity and Diabetes[5], which seeks to fight these problems via the promotion of healthy habits and lifestyles, the generation of public spaces dedicated to physical activities and the capacitation of health personnel.

Given the importance of overweight and obesity in the Mexican public health's agenda, it is essential to study the key factors behind their prevalence. In this paper we examine the phenomenon of parental transmission of anthropometric outcomes, which is likely to be contributing to the high persistence of these problems. Since the definitions of overweight and obesity are closely related to very specific measures such as weight and height, it is useful to analyze the behavior of an anthropometric outcome whose calculation involves the use of these variables, such as the Body Mass Index (BMI). This concept has been widely used in several medical and economic research, and is now a generalized way to measure and classify the anthropometric status of an individual. The popularity of the BMI as anthropometric measure lies in its simplicity of calculation and the way it can be easily used to determine how much a person's body weight differs from what is desirable and healthy according to their height.

1.2. Literature review: the determinants of child health outcomes and the process of intergenerational transmission.

A question that has been widely addressed in the literature is: what factors determine whether a child is underweight, overweight or obese? In general terms, the influences affecting a child's anthropometric outcomes can be classified in two categories: those that are purely external and have nothing to do with any parental influence (such as health issues caused by random accidents or the positive effects of a government program aiming to improve the child's level of health and welfare) and those influences attributed to a parent-child transmission (such as genetic factors and the behavioral and socioeconomic environment that the parents provide). Examples of the behavioral and environmental components of the parental transmission are easily found in the literature. Currie and Moretti (2007) use a data set based on California births from infants born between 1989 and 2001 to study the intergenerational transmission of birth weight and find that family

[5] Estrategia Nacional para la Prevención y el Control del Sobrepeso, la Obesidad y la Diabetes. Secretaría de Salud. México, 2013. http://promocion.salud.gob.mx/dgps/descargas1/estrategia/Estrategia_con_portada.pdf

income and other indicators of parental socioeconomic status such as educational level may influence the child's health by altering the use of prenatal care and modifying health-damaging behaviors like smoking. Another example has to do with the way parents allocate resources among household members, which might vary according to the cultural background and the nature of the economic incentives faced by the parents. Some households have a stronger preference for their sons over their daughters and may decide to give them a greater portion of food and economic resources. There might also be some level of preference for first-borns over the rest of the offspring (Sen, 1990; Dasgupta, 1993). These biases are a consequence of the parents' economic decisions and will inevitably affect children development. Genetics are also an important component of the transmission mechanism since children's genetic information inevitably comes from their parents and this inherited information might contain certain predispositions for a particular body size, health condition or even for a chronic disease. As a general rule, the estimated coefficients associated with the parental transmission of health outcomes are inevitably a mix of both genetic and behavioral or environmental factors since the transmission process takes place simultaneously in these three dimensions. As suggested by Martin (2008), the biological influences often interact with environmental factors in multiple and complicated ways, therefore trying to quantify separately the components of the parental transmission becomes a hard (if not impossible) task.

Socioeconomic factors behind child health

Some of the pioneer works on the determinants of child health were mainly focused on the socioeconomic component of the environmental factor. In this regard, most of the available research seemed to indicate a strong correlation between certain household characteristics and health outcomes for children. Edwards and Grossman (1978), for instance, use data from the U.S. Health Examination Survey from 1963 to 1965 to investigate the relationship between a set of health outcomes for children and some socioeconomic characteristics of the households in which the children lived. The authors analyzed a series of health indicators including: height, weight, parental assessment of the child's health and a set of dummy variables whose purpose was to identify whether the child suffered from specific health deficiencies. According to their results, parents' schooling, mother's labor force status and family size are important determinants of children's health, whereas income does not seem to have an important influence. Similarly, Wolfe and van der Gaag (1982) apply a simultaneous structural equations model to data extracted from the 1975 Rochester Community Child Health Survey in order to study the determinants of children's health. Their findings suggest that the mother's education and employment, as well as the marital status of the parents (i.e. being married) have a strong positive correlation with children's health. Nevertheless, in this case income is found to have a negative effect. One of the explanations provided by the authors is that high household income may be correlated with the consumption of high-price junk food that deteriorates the child's health. Another possibility is the fact that higher income is usually associated with better parental education, which makes the family more able to identify the presence of child health problems such as allergies, behavioral issues and mental health illnesses. Households whose adult members are less educated and potentially have less income wouldn't be able to notice these health anomalies and would probably overestimate their self-reported assessments of health.

The intergenerational transmission (biological and behavioral influences)

However, socioeconomic factors are not the only variables influencing child health. A few years ago, some studies started to allow for the possibility that genetic predispositions and behaviors directly transmitted by the parents could be playing an important role in the determination of a child's health and longevity. For a sample of Danish twins born between 1870 and 1880, McGue et al. (1993) analyzed the heritability of longevity by assessing twin resemblance for age at death and calculating the extent to which genetic and environmental factors affected the between-individual variation in a life span. According to their results, there were non-shared[6] environmental factors significantly influencing longevity and also a moderate but significant heritable component determining life-span (their heritability estimates being in the range 20-35 percent). Similar results have been found when analyzing other measures of health. Akbulut and Kugler (2007) used data from the National Longitudinal Survey of Youth in 1979 (NLSY79) on mothers and children to document the intergenerational transmission of a set of specific health outcomes that included weight, height, BMI, depression and asthma.

[6] The non-shared environmental influences refer to those external factors that affect the health of an individual only, for example, an accident that harms only a person's health but does not affect the rest of the family.

Under the basic specification they find that 45 percent of the variation in the child's BMI is explained by the variation in the mother's BMI, while this figure goes up to 58 percent for children of immigrant mothers. These results show that both native and immigrant children seem to inherit a significant fraction of their anthropometric status from their mothers, and this strong correlation remains after they control for the mother's characteristics and other household fixed effects. In a study for the 1958 British birth cohort, Li et al. (2009) use multilevel models to analyze the intergenerational transmission of obesity and according to their findings, parental BMI is strongly associated with the child's BMI. Specifically, they find that a one standard deviation increase in maternal BMI between the ages of 11 and 16 years old is associated with an increase in the offspring BMI z score of 0.23. In a more recent study, Coneus and Spiess (2012) use data from the German Socio-Economic Panel (SOEP) from 2003 to 2008 to study the intergenerational transmission of health outcomes in early childhood. Based on anthropometric measures, information on health disorders and self-rated health measures the authors found that, on average, healthy parents tend to have healthier children. The results are quite robust and remain significant after controlling for socioeconomic variables such as parental income, education and family composition. Likewise, Bhalotra and Rawlings (2011) investigated the intergenerational persistence of health from mothers to children in 38 developing countries during the period 1970-2000 and found strong non-linear relationships between the mother's height, BMI and anemia status and the child's mortality risk and anthropometric failure. Specifically, they find that a one deviation decrease in maternal BMI is associated with an increase of 10.8 percent in the risk of low birth weight, while this figure goes up to 13.1 percent for the case of neonatal mortality. Analogous effects can be found in Thompson (2013), in which the author uses samples of adopted and biological children from the U.S. National Health Interview Survey for the period 1998-2011 to analyze the intergenerational transmission of health variables such as: self-rated health level, obesity, asthma and diabetes. According to his findings the intergenerational link associated with these health variables is significantly robust, genetics explaining between 20 and 30 percent of it. However, as it has been mentioned before, the process driving the transmission of health status from parents to children has to do not only with biological or genetic influences but also with behavioral and communicative factors. A useful illustration of this is given by Rimal (2003) who used structural equation models and data from the Stanford Five-City Project, which collected independent cross-sectional data waves in 1979, 1981, 1983, 1985, and 1989, to document the dependency of adult and child eating behaviors on self-efficacy (defined as an individual's ability to exert control over specific behaviors), knowledge and communication between adults and children. According to his results, children seem to have a strong tendency to follow adults' behavior and consequently they also copy their behavioral determinants of health. For example, he finds that adults' dietary behavior along with the children's use of health information, knowledge and self-efficacy explain 48 percent of the variance in children's dietary behavior.

The Size of the Intergenerational Transmission

A question that has also been addressed in the literature is relative to the size of the intergenerational correlation across different levels of household socioeconomic status and the level of the anthropometric outcome itself. Using data on individual birth records from California, U.S., Currie and Moretti (2007) found a strong maternal transmission of low birth weight, which seems to be stronger among poor households. Specifically, they find that children who were born in poverty are 0.040 percentage points more likely to have low birth weight if their mothers had low birth weight; whilst this estimate is 0.022 for non-poor households. Likewise, Bhalotra and Rawlings (2012) used a set of 38 developing countries to estimate the sensitivity of the intergenerational transmission of health to different socioeconomic variables. In this case the authors take infant mortality rate as the dependent variable and maternal height as an indicator of maternal health and the main indicator of intergenerational persistence. According to their results, children who were conceived or born in places facing adverse socioeconomic conditions are more likely to suffer from the transmission of poor maternal health. Specifically, the authors find that a one standard deviation growth in the log of the GDP per capita is associated with a decrease in the intergenerational persistence of 29.6 percent. This result is reasonable since richer countries usually have good public health services that can counteract the intergenerational effect for children of mothers with poor health.

However, income is not the only factor that can influence the extent to which health is transmitted from parents to children. There is evidence showing that the size of the intergenerational persistence of anthropometric outcomes also depends on the level of the anthropometric outcome itself. Using the U.S. National Longitudinal Survey of Youth

1979 (NLSY79) and the Children and Young Adults of the NLSY79, Classen (2010) has estimated an intergenerational correlation of the BMI (between women and their children) equal to 0.35 (namely, an intergenerational elasticity of 0.42)[7]. Nevertheless, this figure is not constant across the sample and the author uses quantile regression to document that this intergenerational persistence becomes higher at greater levels of the child´s BMI. For the full sample, for instance, the intergenerational elasticity is 0.27 for those children in the 10th percentile of the BMI distribution, and this figure gradually grows for higher levels of the child´s BMI, reaching 0.58 for children in the 90 quantile.

Additionally, some other researchers have raised the question of whether the mother's and the father's health outcomes are equally important in the determination of the children's situation. Whitaker, et al. (2010) used pooled data for English families between 2001 and 2006 to quantify the individual and joint effects of maternal and paternal overweight and obesity risk in children. What the authors found was that the mother-child associations for the BMI were significantly stronger than the father-child associations, independently of the child's gender (correlations of 0.27 for mothers and 0.23 for fathers, even after adjusting for undisclosed non-paternity[8]). Finally, in a study for intergenerational correlations of height using data from Vietnam in 1993, Venkataramani (2011) found that there are strong parental associations that are robust to the inclusion of household and parental characteristics (from the general specification the author finds that one standard deviation increase in parental height is associated with between 0.18 and 0.20 standard deviation increase in child height z-scores). He also finds that the maternal relationship seems to be approximately 60 percent higher for boys than for girls, the difference being significant at the 10 percent level. Then, when the author uses the conditions faced by parents in early life as instruments for the parents' heights, he gets an even larger mother-child association, whilst the father-child link almost disappears. In contrast, Dolton and Xiao (2015) use data from the China Health and Nutrition Survey (CHNS) covering the period 1989-2009 and find that the size of the father-child association in BMI is slightly larger than in the case of the mothers for almost all OLS and fixed effects specifications.

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[7] The author explains that in this case the correlation is lower than the elasticity because the standard deviation of maternal BMI is lower than that of their children.

[8] The authors recognize that "undeclared non-paternity can result in an underestimate of the observed difference between maternal and paternal associations". Consequently, they use sensitivity analyses to take this possibility into account.

1.2.1. The intergenerational transmission of health and anthropometric outcomes: Evidence from Mexico.

The existence of a family transmission process for health and anthropometric outcomes has been also documented for the Mexican case, yet literature in this matter is not very abundant. Rodriguez-Oreggia and Perez (2010) used the 2002 and 2005 waves of the Mexican Family Life Survey to analyze the factors of social dynamics associated with the determination of BMI in adults. According to their results, those individuals living in households with a high incidence of overweight and obesity among their family members are more likely to be overweight and obese, relative to people living in households whose members have a normal weight. Specifically, having a higher obesity index within the household is associated with an increase in the male individuals' BMI of 3.94-6.79 percent (depending on the model specification) and these figures are similar for the female individuals (around 3.5 -6.5 percent). The authors conclude that the family environment is an important determinant of the BMI outcomes, yet they recognize the fact that this relationship might also be influenced by genetic factors.

Some other studies have attempted to find a more direct relationship between parents and children. As part of a study of the intergenerational transmission of adiposity across six countries, Dolton and Xiao (2014) analyze the elasticity of transmission between Mexican mothers and their children using panel data from the Survey for the Evaluation of Urban Households (ENCELURB) for three years: 2002, 2004 and 2009. According to their findings the mother-child elasticity of the BMI for urban households is 0.112, once the analysis controls for the child's age and gender. However, these results might not be significant for the whole population since rural households are omitted from the estimation. Also, since the father's anthropometric information is not available in the survey, it is quite possible that the estimation of the mother-child elasticity is slightly biased due to the presence of assortative mating.

Another branch of literature has focused on the identification and analysis of risk factors that may enhance the presence of overweight and obesity on children, considering the presence of obesity in the parents as one of these factors. As expected, some of them have found strong links between child obesity and parental anthropometric outcomes. Shamah-Levy, et al. (n.d.) used a sample of 60 elementary public schools to analyze the relationship between Mexican school-age children obesity and the BMI of their parents. According to their results, there is a close relationship between the weight status of the parents and the anthropometric measures of child. Specifically, they find that more than 80 percent of children with obesity or overweight problems had parents that were also obese or overweight. Similarly, Klünder- Klünder, et al. (2011) carried out a study of treatments and controls in 9 primary schools in Mexico City and calculated the risk for a child to have obesity problems using the nutritional situation of the parents as explanatory variable. They find that the odds ratio (OR) of a child being obese when the father is overweight is 3.9 whilst this figure goes up to 12.1 when the father is obese. For the mothers these estimates are 4.5 and 6.5, respectively. These results make them conclude that there is indeed a close relationship between the anthropometric outcomes of mothers and children.

Similar results have been found when analyzing other health measures. In the same article, Klünder- Klünder and his co-authors also analyze the mother-child relationship on blood-pressure. Just as in the case of obesity, they find that those children whose parents presented high levels of blood pressure tended to have higher blood pressure values than children whose parents had low levels of blood pressure. Likewise, in a study conducted by Velasco, et al (2010) the authors use data from the National Health Survey (ENS) of 2000 for Mexican people and replicated observations from the National Health and Nutrition Examination Survey for Mexican-American citizens living in the United States to carry out a diabetes risk assessment. They find that in the absence of obesity, having diabetic parents is a significant risk factor for type 2 diabetes and this influence is higher for lean individuals.

1.2.2. The use of panel data in the study of the intergenerational transmission of BMI

Although most of the studies in the intergenerational transmission literature have used cross sectional data, having one single observation for parents and children in a specific point of time may arise some difficulties in the analysis of this relationship. First of all, even when a study accounts for an exhaustive set of controls, there is always a possibility that some unobserved factors might be influencing both the anthropometric measures of parents and children. This unobserved heterogeneity may be caused either by individual intrinsic factors (such as genetic conditions) or by household specific characteristics that are not usually observed (for example family habits or decision making processes inside the household). Usually, when using cross sectional data the solution to the endogeneity problem is to use instrumental variables, however it is hard to find appropriate instruments that don't compromise the credibility of the analysis (Garcia and Quintana-Domeneque, 2007). In an attempt to overcome these problems, some studies have chosen to use data sets with a panel structure. Dolton and Xiao (2015) use the CHNS data base from 1989 to 2009 to document the intergenerational transmission of the BMI in China. In their study, the authors recognize the presence of unobservable heterogeneity at both individual and household level and follow a fixed effects methodology to deal with potential endogeneity coming from these unobserved factors. Under the OLS specification they find that one standard deviation increase in the father's BMI z-score is associated with an increase of 0.223 in the child's BMI z-score, whilst this figure is 0.208 for the case of the mother. When using individual fixed effects, these estimates go down to 0.151 and 0.160 respectively, whilst both converge to 0.152 when applying household fixed effects. Brown and Roberts (2012) use the British Household Panel Survey from 2004 to 2006 to carry out a decomposition analysis of the intergenerational correlation in the BMI of mothers and their adolescent children. However, instead of using a simple Ordinary Least Squares (OLS) approach they follow a Restricted Maximum Likelihood (REML) methodology that takes into account the individual and household fixed effects. Then, the intergenerational correlation is defined as "the fraction of the overall variance in BMI that stems from shared family background characteristics". In other words, the authors define the intergenerational correlation as the result of dividing the variance that is due to differences between families by the total variance in BMI. For this analysis the authors estimate an intergenerational correlation of 0.25. Once this figure is calculated, the authors monitor the change in this variable when socioeconomic variables are gradually added to the analysis in order to measure their contribution to the intergenerational correlation. In general, all the observable factors included in the decomposition analysis such as maternal characteristics and adolescent's behavior account for 11.2 percent of the intergenerational correlation.

Using panel data can also help to clean the estimation from measurement errors. Classen (2010), for instance, uses longitudinal data for mothers and adolescents when they are both between 16 and 24 years old to analyze the intergenerational transmission elasticity of BMI, which is estimated to be 0.42 for the full sample. In this case, the author averages all the available observations for each individual across time and uses these averages to estimate his model. The author explains that this kind of approach helps him to mitigate possible bias from measurement error due to temporal variation in the anthropometric outcome. One disadvantage of this kind of approach is that by averaging observations a considerable portion of information is lost in terms of year-to-year variations that could help us to get better estimates of the intergenerational link.

Some other studies only have access to panel data for one of the generations. This is the case of the work by Castelnovo (2014) who calculates an estimate of the intergenerational elasticity of BMI using the British Cohort Study of 1970. Although the author has access to information on the children for three different years (when they are 10, 16 and 34 years old, taken from the 1980, 1986 and 2004 survey, respectively) he only has information in one point of the time for the parents of this specific cohort (1980 survey). Even though this amount of data might be good enough to calculate the persistence of the intergenerational transmission elasticity, the endogeneity problems caused by unobserved heterogeneity arise again, just as in the case of cross sectional data. The author recognizes this difficulty and dedicates a whole separate section of his analysis to explore possible sources of endogeneity coming from the parental education variable. In this case, the author decides that the best way to overcome these issues is by applying instrumental variables. However, since he does not have access to appropriate instruments for parental education, he follows an alternative methodology known as "the Lewbel approach", a special variation of the traditional instrumental variables methodology. According to his results, the maternal intergenerational elasticity varies (depending on the specification) from 0.09 to 0.25 for male children and from 0.11 to 0.38 for females; whilst the paternal elasticity varies from 0.08 to 0.23 and from 0.13 to 0.35, respectively.

For the Mexican case, the most noteworthy work in this topic using panel data is the research performed by Rodriguez-Oreggia and Perez (2010) in which the authors use the Mexican Family Life Survey for 2002 and 2005 to investigate the social dynamics determining obesity in Mexican adults. In this case, the authors recognize that since both the social dynamics and the eating and exercising habits might be endogenous, it is convenient to use a fixed-effect methodology (just as in Dolton and Xiao, 2015). In order to rule out any unobserved heterogeneity the authors perform their regression analysis following four approaches: random effects for individuals and households and fixed effects also for individuals and households. According to their results, most of the eating and exercising habits have an effect on the individual's BMI under the random effects specification, but not when using fixed effects models. Conversely, the effect of having obese individuals in the same household is significant under any specification, from which the authors conclude that social aspects are important in the determination of weight. However, they do not rule out the possibility that this effect might also be including a genetic component and it is practically impossible to infer from their results how much of this correlation is due to parental transmission.

1.3. Objectives and contribution

This paper will attempt to study in depth the intergenerational transmission of BMI from parents to children using panel data from the Mexican Family Life Survey (MxFLS) in 2002, 2005 and 2009. The main objectives of this research are to calculate an estimate of the parental transmission of BMI for both parents and their children and to investigate the sensitivity of the parent-child correlation to the child´s characteristics, the household socioeconomic level and the anthropometric status of the parents.

The study of the intergenerational transmission of BMI presented in this document will contribute to the existing literature in the following ways. First of all, this paper represents the first formal attempt to properly calculate the intergenerational correlation in BMI for both parents and their children using panel data from a Mexican survey that is representative at the national level. Unlike Rodriguez-Oreggia and Perez (2010), our main focus here is to measure the parent-child anthropometric relationship in a detailed way, rather than study the effect of having family members suffering from obesity on the individual's BMI. The analysis ran by Rodriguez-Oreggia and Perez concludes that having obese people in the family is associated with a greater BMI measure. However, this estimation is clearly a mix of many mechanisms going on inside the household and we can't really tell how much of this familial relationship is due to a parental transmission and how much of it happens in a social context that might also include the behavioral influence of siblings and other members of the family. When designing welfare policy to help children overcome health problems such as obesity it will be useful to know how much can be done by specifically altering the parents' information and behavior. Therefore, in this study we are mainly interested in the transmission process from parents to children so we can quantify how the BMI of a child can be influenced by the parents' behavior and their own anthropometric condition.

Unlike the work done by Dolton and Xiao (2014) in their cross-country analysis, in this document we have used data from a representative sample that includes rural and urban households and compiles anthropometric information for both parents. In their study, the authors find a significant relationship between the BMI of small children and the BMI of their mothers; however, these results might not be applicable for the whole Mexican population (since rural households were omitted). Also, their work does not study the father-child association of BMI. In this paper we estimate the parental transmission of the BMI using the Mexican Family Life Survey (MxFLS), a longitudinal dataset that is representative at the national level (including rural and urban populations) and compiles anthropometric information for the child's mother and father.

Although we follow the methodology used in the study of the Chinese case performed by Dolton and Xiao (2015), in the sense that we also start from the simplest specification using ordinary least squares (OLS) and then gradually consider more sophisticated models using fixed effects estimates, our analysis departs slightly from the one they did. Once they estimated the intergenerational correlation, they use quantile regression to estimate whether the strength of the transmission is different across the distribution of the child´s BMI. They find that the parental link tends to be higher for children with high BMI z-scores, from which they conclude that obese and overweight children are more likely to have inherited their condition from their parents. In this paper we see this fact from a different perspective. Since the causality goes from parents to children, we would like to know whether the fact that a parent has certain anthropometric status, such as obesity and overweight, makes him or her more prone to transmit his or her own condition. For this purpose, we include interaction terms indicating the anthropometric condition of each parent, instead of running quantile regressions, as Dolton and Xiao did.

2. Sample

In this section we provide information about the survey we are going to use for our study and present a descriptive analysis of some of the most important anthropometric variables for children and parents.

2.1. The Mexican Family Life Survey (MxFLS)

In this study we use all three available waves from the Mexican Family Life Survey (MxFLS), a longitudinal database that covers a wide variety of topics on socioeconomic, demographic and health indicators and that is representative at the national, urban, rural and regional level. The survey compiles the information of a large set of households and individuals for three periods: 2002, 2005-2006 and 2009-2012[9].

Since the main interest of this paper is to analyze the process of parental transmission of the BMI, the key variables to consider are those referent to the anthropometric condition of the individuals, namely, their height and weight (relative to their age). Then, in order to control for the socioeconomic status of the family we use additional variables such as the household's level of income, the number of bedrooms per capita in the house, the classification of the father's occupation, the mother's last level of education and the total size of the household.

2.2. Summary Statistics

For our research purposes, we have restricted the sample to contain only children and adolescents between the ages of 0 and 19 that have complete anthropometric and biological information (i.e. weight, height, age and gender) so a BMI measure could be calculated for them. After cleaning our data set from biologically implausible outliers[10] we end up with a total sample of 30,209 children. Table 1 presents the number of observations per year, depending on the availability of the parents' anthropometric information. Under a pooled cross-section framework we work with a total of 14,169 observations (containing information for children and both of their parents), most of them coming from the first survey (2002) and the rest being equally distributed between the other two waves of the panel (2005 and 2009). Table 2 shows the number of individuals interviewed across different number of waves. Fortunately, we notice that almost 70 percent of the individuals appear at least twice in the panel (i.e., they have anthropometric information for two years). Having repeated observations for a single

[9] These periods refer to the amount of time that was required to collect the sample for each of the three waves of the panel. For simplicity we will refer to each wave as: 2002, 2005 and 2009.
[10] According to the WHO, only BMI values whose z-scores are between -5 and 5 should be considered as biologically plausible, so we use these criteria for children and parents. We also eliminate those observations of children for whom gender is not registered to be constant over time and whose parents were reported to be outside reproductive age at the time of the child's birth.

individual is an important advantage since it provides additional information that might be useful to clean the analysis from unobserved heterogeneity that could be affecting the estimation of the parental transmission.

In this section we conduct a simple descriptive analysis for the most important anthropometric variables in our study, which have to do with the individuals' height and weight. The reader will notice that instead of analyzing the individual's BMI itself we have chosen to employ a z-score of the BMI, which considers how far or close is an individual's BMI from the mean in a reference population. Thus, a very high and positive z-score would indicate that a person's BMI is much higher than the mean in the reference population, suggesting that the person is very likely to be at high risk of overweight or obesity. As in Dolton and Xiao (2015) we use two sets of reference populations: the 2006 WHO Growth Standards for children aged between 0 and 5 years and the 2007 WHO Reference group for children and adolescents between the ages of 6 and 19. The 2006 WHO reference population uses data collected from Brazil, Ghana, India, Norway, Oman and the US; whilst the 2007 WHO standards are based in a sample of children from the state of Ohio in the United States. The conversion from BMI values to z-scores for children and adolescents aged 0 to 19 can be easily computed by running a simple software routine designed by the WHO[11]. Since the body size and complexion of an individual is not expected to change dramatically from late adolescence to maturity, using this conversion also for the parents becomes convenient and acceptable enough for our research purposes[12]. Table 3 (panels (a), (b) and (c)) show a summary of these variables for children, mothers and fathers. In part (a) we neglect the fact of whether an individual may be registered in the sample more than once and consider all the observations as if they came from independent individuals, while in part (b) we acknowledge the longitudinal nature of the data. Part (c) shows the proportion of individuals in the sample that are classified as obese, overweight, normal weight or wasted according to the WHO standards[13]. First of all, we notice that the mean for the children's BMI z-scores is positive and relatively close to zero, which means that, generally speaking, children in this sample tend to be fatter

[11] The Stata routines can be downloaded from http://www.who.int/childgrowth/software/en/ (for children aged 0 to 5 years) and http://www.who.int/growthref/tools/en/ (for children and adolescents between 5 and 19 years old).

[12] Also following the procedure carried out in Dolton and Xiao (2015), parents whose age is over 19 are treated as if they were exactly 19 years old, in order to calculate the z-scores.

[13] The document explaining this classification can be found at: http://www.who.int/childgrowth/training/module_c_interpreting_indicators.pdf

than their reference populations. A second fact we notice is that regardless of the approach we consider, the mean of the BMI z-score for the mothers tend to be higher than for the fathers, suggesting that the first group tend to be heavier than the latter. Finally, if we compare the mean values for the BMI z-scores for the three waves of the panel we can see that they generally grow through the years for all groups, and given that the parameters of the reference population are constant over time this means that the sample as a whole has been getting fatter.

3. Methodology

3.1 The use of BMI z-scores in the measurement of parental transmission.

The Body Mass Index (BMI) is a measure that has been traditionally used to estimate the level of body fat and helps to determine whether a person's weight is healthy or normal, according to their height. This measure is calculated as follows:

$$BMI = \left[\frac{weight(kg)}{height^2(cm)}\right] * 10{,}000 \tag{1}$$

The main objective of this paper is to measure the parental transmission of the BMI in children and adolescents. However, simply regressing the BMI of the child on the parents' BMI is not likely to give us accurate estimations. First of all, since small children are still growing up, it is obvious that the BMI that is healthy or normal is not going to be the same for individuals of all ages. Similarly, as the growing process is different for boys and girls, we shouldn't directly compare their BMI nor pool them all together in the analysis. Consequently, we need to find a standardized measure that captures how low or high the child's BMI is, regardless of their age or gender. Thus, we calculate the z-score of the child's BMI with respect to a reference population of the same age and sex. Therefore, the z-scores would indicate how high or low a child's BMI is with respect their own age and gender group in that reference population. The z-scores would be calculated as indicated in equation (2):

$$z_i = \left[\frac{BMI_i - BMIR^*}{\sigma_{BMIR}}\right] \tag{2}$$

Where BMI_i represents the child's BMI while $BMIR^*$ and σ_{BMIR} are respectively the mean value and the standard deviation of the BMI in their correspondent reference population (which can be found in the 2006 or 2007 WHO sets of reference groups, depending on the child's age).

3.2 Model and Estimation Strategy

The next step is to specify a model that formalizes the parent-child association of anthropometric outcomes, in this case the BMI. Our baseline model is shown in equation (3)[14].

$$y_{ijt} = \beta_0 + \beta_1 m_{ijt} + \beta_2 f_{ijt} + \gamma c_{ijt} + \partial r_{ijt} + \varphi x_{ijt} + \theta w_{ijt} + u_{ijt} \qquad (3)$$

Where y_{ijt} indicates the BMI z-score of the child "i" from household "j" in wave "t", m_{ijt} and f_{ijt} represent the BMI z-scores for the child's mother and father, respectively, also in wave t[15]. Therefore, β_1 and β_2 represent how much of the variation in the child's BMI z-score can be explained by the variation in the BMI z-score of the mother and father, respectively. The term c_{ijt} represents a vector of basic controls that are included in the estimation in order to consider the heterogeneity coming from the child's age and gender, as well as the parents' age. The reader should keep in mind that the z-scores we are working with consider the position of the child's anthropometric levels relative to a selected sample of children of the same age and gender, thus these measures do not have to be cleaned out to consider any gender or age effects. However, it is possible that the relative position of a child in the distribution of BMI of their reference group itself could be related to the child's age and gender. For example, there could be a parental preference for male children for cultural and traditional reasons, which could be affecting the amount and quality of food they get in comparison with female children. Or it could be the case that parents have a greater preference for babies and small children over adolescents. In

[14] Our baseline model keeps the essence from the one used in Dolton and Xiao (2015) for the Chinese case, though some small details have been modified.

order to consider this possibility we include the child's age and its squared term, as well as their gender and its interaction with age. However, even when we control for age and gender, there could be an additional source of endogeneity coming from the fact that we are using two sets of reference populations. As mentioned before, in order to build the z-scores we use the WHO child growth standards of 2006 and 2007, for infants between 0 and 5 years old and children and adolescents between 6 and 19, respectively. Since the reference populations of these standards were calculated using samples extracted from different countries (United States for the 2007 WHO reference and a mix of developing and developed countries for the 2006 standards), one should consider the possibility that children's overweight could be "accentuated" under one of the specifications. For example, it could be the case that all children whose z-scores were calculated under the WHO 2007 standards might tend to have greater measures of their z-scores just because the standard deviations of the reference samples are lower than the ones used to calculate the z-scores under the WHO 2006 standards, which is very likely as the latter uses a wide sample of children from 6 different countries. In order to make sure we account for this possibility we include a dummy variable, r_{ijt}, to indicate whether the z-score of the child was calculated under the WHO 2007 standards, as opposed to the 2006 reference. Finally, our model should acknowledge the fact that the anthropometric condition of a child or teenager could also be a function of the availability of resources in the household and other family characteristics. For this reason we include vector x_{ijt} which represents a set of variables describing the socioeconomic status and general characteristics of the child's family such as the level of household income, the number of bedrooms per capita in the house, the father's occupation, the mother's last level of education and the total size of the household. The last vector in our model w_{ijt} represents a set of time and region dummy variables, as well as their interaction terms. By including these controls in the estimation we are trying to take into account any trends in the children's anthropometric condition and any other transitory circumstances taking place in a certain region of the country that could have affected the anthropometric outcome of the children living there.

What the transmission coefficients in equation (3) tell is the extent to which the BMI of the child is associated with the one of the parents. However, these estimates include a mix of genetic, behavioral and environmental factors that are transmitted or shared by the family and do not provide any information about the specific causality or mechanism that is driving this correlation (Dolton and Xiao, 2015). Fortunately, we can partial out the time-invariant components of the parental transmission. Using a household-specific intercept in equation (4), say β_j, will allow us to capture all the behavioral and environmental factors that are common to all the members of the household "j" but remain constant over time, such as general food preferences, relative decision-making power of each member of the household, or special preference for certain child in the allocation of resources, as suggested by Dolton and Xiao (215), following the ideas of Qian (2008) and Dasgupta (1993). This household fixed-effects term also captures the social environment to which all family members are exposed and that could be affecting their weight status. An example of this kind of influence is given by the "factors of social dynamics" studied by Rodriguez-Oreggia and Perez (2010) who argue that having a large number of obese people living in the household has an obesity-enhancing effect on the rest of the members via social interactions, independently of their kinship. Then, as long as the strength of these interactions is relatively stable over time their effect will be included in the β_j term.

$$y_{ijt} = \beta_j + \beta_1 m_{ijt} + \beta_2 f_{ijt} + \gamma c_{ijt} + \partial r_{ijt} + \varphi x_{ijt} + \theta w_{ijt} + u_{ijt} \tag{4}$$

Alternatively, we can choose to isolate the genetic component of the parental transmission by performing a fixed-effects regression at the individual level. By substituting β_j by β_i in equation (4) we can estimate how much of the variation on the child's BMI can be explained by the variation on the parents' BMI, independently of the effect of genetics and any other non-shared habits and behaviors that could be affecting the child's anthropometric condition.

Next, we use our baseline model described by equation (3) to measure how the size of the parental transmission differs according to: i) the child's age and gender, ii) socioeconomic characteristics of the household and iii) the level of the parental BMI. The latter sensitivity analysis will be useful to identify the presence of intergenerational vicious cycles of unhealthy BMI outcomes.

4. Results

This section presents the results of estimating a measure for the parental transmission using equation (3) and (4). As explained before, the main objective of this paper is to provide a measure of the size of the parental transmission of BMI for the Mexican case and explore how this relationship varies according to the child's age and gender, the household characteristics and across the distribution of the parents' BMI outcomes. In the first sub-section we discuss the results of estimating the parental correlation using an Ordinary Least Squares (OLS) approach, whose calculations include all the genetic, environmental and behavioral factors involved in the transmission process. Next, we present the results of estimating a fixed-effects model at the household and individual level, where we partial out all time-invariant factors that are intrinsic to each household and individual. In the third subsection we present the results of adding interaction terms to consider possible variations in the size of the transmission considering the child's age and gender, the household's socioeconomic characteristics and the level of BMI of the parents.

4.1 Pooled Ordinary Least Squares Estimation (OLS)

As a first step in the estimation procedure and in order to provide a first insight to the size of the transmission coefficients, we pooled all the observations regardless of the fact that they come from different years. Following this procedure allows us to quantify the total size of the parent-child relationship, including all the possible transmission channels (genetics, learned behavior and shared environment).

Table 4 shows the pooled Ordinary Least Squares (OLS) results of estimating equation (3). Departing from a very simplistic specification in which the child's BMI z-score is exclusively explained by the parents' BMI z-scores, we estimate an intergenerational correlation of 0.231 for the mother and 0.211 for the father (column (3)), both significant at 1 percent. This means that one standard deviation increase in the mother's BMI is associated with an increase of 0.231 standard deviations in the child's BMI. Similarly, one standard deviation increase in the father's BMI is associated with an increase of 0.211 standard deviations in the child's BMI[16]. Since both transmission coefficients increase

[16] This interpretation applies only in this particular context, since both variables (dependent and explanatory) are z-scores, and therefore have a standard deviation of 1.

when they are considered separately in the model (columns (1) and (2)), we can assume there is some level of correlation between the mother's and the father's BMI status, so the mother's influence on the child's BMI is somehow "absorbed" in the father's transmission coefficient when the mother is omitted from the equation, and vice versa. Consequently, a model that attempts to estimate a coefficient of parental transmission considering only one of the parents at a time is very likely to be biased upwards.

In columns (4) and (5) we introduce the child's age and gender as additional explanatory variables. As mentioned before, even though the z-scores are free from any gender or age affect, it is important to include such variables in the estimation to recognize the fact that the relative position of a child's BMI in the distribution of the reference population could be correlated with the child's age or gender. The first fact we notice is that the BMI z-score tends to decline as children grow up, suggesting that, on average, obesity might be a graver problem for small children that it is for adolescents. Also, the coefficient associated with male children is positive and significant under any of the specifications, suggesting that, on average, boys tend to be heavier than girls. However, the negative sign of the interaction term for age and gender introduced in column (5) suggests that the gender gap tends to shrink as the individuals grow up. Given that the z-scores already take into account the biological differences between boys and girls, this could mean that there might be a certain preference for boys over girls in terms of food allocation, which tends to disappear as children get more autonomy over the amount and kind of meals they eat.

From columns (6) to (10), we include an additional set of variables to control for the parents' age. Once again, this allows us to control for any correlation between the child's anthropometric situation and the parents' age, which could be a problem if parents of certain age group also tend to have a BMI z-score that is higher or lower than the rest. We notice that on average, children of older parents tend to be leaner, a result that is especially significant for the case of the father. The small size and lack of significance of the quadratic terms associated with parental age in most of the specifications suggest that the relationship between the parents' age and the child's BMI might be in fact linear. Before any other set of socioeconomic controls is introduced (column (6)), we notice that including the parents' age and their quadratic terms has a boosting effect on both transmission elasticities, though this influence is slightly higher for the mother (whose estimated coefficient goes from 0.240 to 0.247).

Next, we include a set of controls attempting to capture the household's socioeconomic situation via specific features such as: the classification of the household's level of income (measured as a dummy variable indicating the quantile classification), number of people living in the household, number of bedrooms per capita, as well as the classification of the father's occupation and the mother's last educational level (column (7)). In column (8) we keep the household's characteristics in the estimation while including regional dummies indicating whether the household is located in the North, Center-North, Center or South[17] (see figure (3)). Then, we incorporate dummy variables to account for the year each observation belongs to, as well as a set of interactions to consider possible events or external influences that happened in a specific region in certain year which could have had an effect on children's anthropometric measures (columns (9) and (10)). Once the household's characteristics are included in column (7), we notice that both parental correlations adjust slightly and remain almost unchanged as we keep adding the rest of the controls. Then, taking the complete specification represented in column (10) as reference, we find a maternal and paternal transmission coefficient of 0.254 and 0.214, respectively. This result indicates that a mother's BMI outcome that is one standard deviation above her reference mean is associated with her child's BMI being 0.254 standard deviations above its reference mean, assuming the rest of the variables in the model are held constant. Analogously, a father's BMI measure that is one standard deviation higher than his reference mean is associated with a child whose BMI is 0.214 standard deviations higher than his or her reference mean, assuming that the rest of our controls remain constant.

4.2 Fixed Effects Estimates

In the previous section we calculated a parental correlation that comprises a mix of different transmission mechanisms including genetic factors, learned behavior and shared environment. However, given the longitudinal nature of our data it is possible to isolate some of these mechanisms by following a fixed effects approach. In this section we use household and individual fixed effects to partial out the time-invariant factors influencing the children's anthropometric condition.

[17] We have used the regional classification employed by Mexico's Central Bank (Banco de México) in the elaboration of the Report of Regional Economies. The reports are available at: http://www.banxico.org.mx/publicaciones-y-discursos/publicaciones/informes-periodicos/reportes-sobre-las-economias-regionales/reportes-economias-regionales.html

4.2.1. Household Fixed Effects

In this subsection we present the results of following a fixed effects approach taking the household as reference category. In this case we intend to partial out the time-invariant factors that are common to all the individuals living in the same household and that have an influence on their BMI. Examples of this kind of influences are sleeping and eating habits, traditions, cultural factors as well as any specific preferences regarding the allocation of resources within the household[18]. For this purpose, we estimate the model represented by equation (4).

Table 5 shows the results from following this procedure. According to the estimates shown in column (1), once the household effect has been removed from the parental correlations, the mother-child and the father-child transmission coefficients are estimated to be 0.067 and 0.070, respectively. Since we are taking out the time-invariant influences that are common to all the members of the household, such as general preferences, cultural factors, strength of social interactions inside the home, and even shared genetic predispositions, it is still not surprising that the sizes of both parental transmission coefficients shrink with respect to the OLS estimation. Although both estimates are still significant at 10 percent, we notice that the fall in the size of the mother's coefficient with respect to the OLS is remarkably higher than the case of the father's, suggesting that shared genes, family habits and common preferences in the household might be playing a more important role in the maternal transmission than in the paternal one. As the household's socioeconomic characteristics are included in the estimation (column (2)), the maternal correlation shrinks in size and loses its significance, whilst the father's transmission coefficient marginally grows in size keeping its significance level. Once we include region and time dummies in column (3), the maternal link keeps weakening at the same time that the father's correlation seems to get even stronger. What we get from these facts is that even when the maternal transmission process appears to go beyond shared family habits and other characteristics, there must be at least one element from the set of variables called "Household's socioeconomic status" that is playing an important role on it, so when it was explicitly included in the estimation the maternal BMI z-score was not significant

[18] Since a portion of genetics is shared among family members (parents and children, siblings and other relatives), using household fixed effects also takes out a small fraction of the genetic component, however it does not entirely isolate it as in the case of the individual fixed effects.

anymore. An interesting exercise is to compare column (1) and (2) from Table (5). Since in both models we are controlling for household fixed effects, the only difference between them is that in the latter we also control for other socioeconomic characteristics that might not be included in the household fixed effect. The reader can think of the father's occupation or the mother's education as examples of those factors. So, for instance, two cousins living in the same house may have different BMI z-scores because the decisions involving their nutrition and health are made by different mothers that could have different levels of education. In this sense, the drop in the significance of the maternal coefficient from column (1) to (2), seems to suggest that the strength of the mother-child relationship could be driven by the mother's socioeconomic condition, measured by her education in this case. Conversely, the father's correlation seems to be resistant to the inclusion of both household fixed-effects and the socioeconomic status of the family. Even though the reduction in the coefficient size from the OLS estimation to the Household Fixed Effects one indicates that at least some portion of the father-child relationship was driven by shared genetics, habits and general characteristics of the family, the significance of its associated coefficients across specifications suggests that the strength of the paternal link might also have to do with other factors. Using the complete specification of column (3), we estimate that, once we control for household fixed effects, a mother whose BMI is one standard deviation above her reference mean is associated with children whose BMI are, on average, 0.045 standard deviations above their reference mean; whilst a father whose BMI is one standard deviation above his reference mean is associated with children whose BMI are, on average 0.075 standard deviations higher than their reference mean, the latter estimate being significant at 5 percent.

4.2.2. Individual Fixed Effects

By substituting β_j for β_i in equation (4) we capture all the individual-specific factors influencing the child's anthropometric condition in the β_i term, so the parental transmission estimates exclude any genetic components and account only for the mechanisms that involve non-fixed influences such as transitory environmental conditions and behaviors. Table 6 presents the results of estimating such a model.

Just as in the case of the household fixed-effects regression, once we apply the fixed-effects methodology at the individual level there is a considerable reduction in the size of both parental transmission coefficients with respect to the OLS results, which is what we were expecting since we are taking out the effect of genetics and habits that are fixed over time[19]. Interestingly, we notice that the mother-child link loses all its strength and significance this time, while the father's transmission coefficient grows in size (in comparison with the household fixed-effects approach) and is now significant at 1 percent. As the socioeconomic controls are included in the estimation, the father's coefficient keeps its size and significance whilst the maternal link keeps shrinking. Taking the complete specification shown in column (3), we find a transmission coefficient of 0.035 for the mother and 0.099 for the father, which means that once the effect of genetics has been taken out, a mother whose BMI is one standard deviation above her reference mean is associated with a child whose BMI is 0.035 standard deviations above his or her reference mean. Similarly, a paternal BMI that is one standard deviation above its reference mean is associated with a child's BMI that is 0.099 standard deviations greater than its reference mean, this correlation being significant at 1 percent. These results suggest that, unlike the maternal transmission, the father-child relationship seems to be based in factors that go beyond a simple genetic correlation. This might be reflecting the greater bargaining and decision-making power of the father inside the household, which could be fueled not only by psychological and cultural factors but also economic influences. Since more than 90 percent of the fathers in the sample are reported to be working, while only 30 percent of the mothers are, the greater father-child association under the individual fixed-effects specification could be reflecting the fact that children are more likely to consume food that is compatible with the breadwinner's time-variant preferences and choices[20].

At this point, it is convenient to compare the individual and the household fixed effects estimates and understand the different intuition behind them. As commented before, in the individual fixed effects approach we are taking out the effect of all those time-invariant factors that are intrinsic to each individual and that might be having an effect on their anthropometric condition, which in this case refers mostly to genetics and its role on the transmission of biologically predetermined trends. What remains in the individual

[19] As we are taking out the effect of genetics we are also neutralizing the biasing effect of any existing correlations between genetics and other determinants of the child´s weight.
[20] Once we restrict the sample to only consider children whose both parents work, the significance of the father-child link disappears (see Table A2 and A3 in the Appendix).

fixed-effects estimates is then a mix of environmental and behavioural influences that vary over time and have an effect on the children's BMI. Inversely, when we estimate the model under a household fixed effects approach we are cleaning the parental correlation from the influence of time-invariant factors common to all the individuals living in the same household and that have an effect on their BMI, such as cultural and environmental factors affecting the BMI of all the members of the family. In general, we observe that the paternal correlation seems to be stronger and more resistant to both fixed effects procedures than the maternal one. This suggests that the father-child link in BMI cannot be totally explained by either genetics (individual fixed effects) or time-invariant habits and cultural factors affecting all members of the household (household fixed effects)

4.3 Determinants of the size of the parental transmission

In this section we analyze how the size of the parental transmission changes across the distribution of a variety of factors. First, we investigate whether the degree of parental correlation varies according to the child's age and gender. Secondly, we measure the size of the transmission across the distribution of different variables describing the household's socioeconomic status. Finally, we study how the strength of the parental transmission changes across the distribution of the parents' BMI; in other words, whether parents of certain weight classification are more prone to transmit their condition than the rest.

4.3.1 Child's age and gender

Once we have estimated the parental transmission coefficients, the next obvious question is whether this correlation varies according to the child's characteristics. We would like to know for example, if the parental transmission is a phenomenon that mostly affects children of one gender or of certain age. For this purpose we estimate the pooled OLS model (that includes all genetic, environmental and behavioral factors) and introduce a set of interaction terms to find out whether the size of the parental transmission is higher or lower for certain groups.

Panels (a), (b) and (c) of Table 7 show the results of introducing interaction terms to account for the effect of the child's characteristics on the size of the parental correlation. Table 7 (a) displays the effects of introducing gender interaction terms in the estimation. We find that, on average, boys tend to experience a greater transmission from their fathers and a lower transmission from their mothers, in comparison with girls. Although the differences between both groups are not statistical significant, this result suggests the presence of an role modelling process in which children are more likely to imitate the behaviors and health attitudes of the parent of the same sex.

In order to analyze the effect of age on the size of the parental transmission we follow two different approaches. First, we take the child's age measured in years and use interaction terms with the mother and father's BMI z-scores (Table 7(b)). In other words, we estimate the marginal effect of an extra year in the child's age on the strength of the mother-child and father-child correlations. As shown in columns (1) and (2), regardless of whether we allow or not for a quadratic effect of age on the child's BMI, growing up seems to increase the link between children and their parents, this effect being especially significant for the father-child relationship. Specifically, we find that each additional year in the child's age in associated with an increase of 0.005 and 0.008 points in the maternal and paternal correlation, respectively. This result might be reflecting the fact that older children tend to have meals that are more similar to the ones consumed by the parents, in comparison with babies and small children. Nevertheless, the previous estimates are implicitly assuming that the marginal effect of age on the size of the parental transmission is the same across the distribution of the child's age. If we only consider the results from columns (1) and (2), we might end up deducing that the size of the parental transmission always increases with the child's age, which is not necessarily true. As an alternative approach, we classify children into four age groups and build interactions with the parents' BMI z-scores (columns (3) and (4)). The sign and size of the new interaction terms shown in column (4) suggest that older children tend to experience a higher degree of parental transmission with respect to babies and small kids between 0 and 5 years old. However, we notice that adolescents between 15 and 19 years old have smaller maternal correlations than children between 12 and 14, and between 6 and 11. Similarly, children between 12 and 14 years old tend to experience a lower paternal transmission with respect to children in the age groups of 6 to 11 and 15 to 19 years. Moreover, the ages in which the parental transmission coefficients reach their maximum is not the same for both parents. As our estimates show, the highest level of maternal transmission seems to be experienced by preadolescents between 12 and 14 years old, whilst the paternal link reaches its maximum strength among children between 6 and 11 years old. Finally, Table 7(c) shows that combining the marginal effects of age and gender in the same regression does not alter our main results.

4.3.2 Household socioeconomic characteristics

The next question we would like to investigate is whether the size of the parental transmission varies according to the socioeconomic status of the family. In order to answer this question we study the relative strength of the parental transmission across the distribution of the following variables: the household level of income, the father's education and occupation, the mother's education and work status and the number of people living in the household.

First, we consider the quantile of household's income and include its interactions with the parental BMI z-scores. Table 8 shows the results of following this procedure, taking the first quantile as reference category. In the case of the mother-child correlation we notice a u-shaped pattern in which households in the second quantile of the income distribution tend to experience the lowest level of transmission; however these differences are not statistically significant. In the case of the father, we notice a clear positive relationship between the level of income and the size of the intergenerational correlation. As shown in column (1), the fact that the household belongs to the fourth quantile of the income distribution makes the paternal transmission coefficient grow 0.094 points with respect to the households in the first quantile, this estimate being significant at 5 percent. The size and significance of this coefficient suggest that children living in relatively rich households tend to experiment a higher father-child transmission than those in the lower tail of the income distribution. This effect might have to do with the level of economic freedom that the father has, which also conditions the extent to which he can, advisedly or not, transmit his own preferences in terms of food and health habits. A poor father has fewer available choices in terms of what he can offer to his children. So, even if he might want to feed his children with certain foods he personally likes, he might not be able to do so due to economic reasons. A father with a higher economic status has a greater spectrum of choices in which he might be more able to provide his children with food that matches his own preferences.

Secondly, we study the size of the parental transmission according to the father's occupation and education. Table 9 displays the estimated coefficients for each occupation and educational level as well as their interaction terms. The first fact we notice is that the father's educational level does not seem to have any significant impact on the size of his BMI transmission. This result is quite reasonable, since the educational level not always translates into a certain socioeconomic status (one could think, for example, in the case of a well-educated person that is currently in unemployment or that does not have enough working experience to get a well-paid job), and consequently it is not likely to affect neither the BMI status of the child nor the strength of the parental transmission. Inversely, the kind of job that the father has does seem to have a significant effect on the extent to which he transmits his own anthropometric status. Independently of the specification we use we notice that children of parents who work as agricultural laborers tend to experience a lower degree of transmission (since agricultural workers are our base category and all the interaction terms correspondent to the rest of the occupations turned out to be positive). We also note that children whose fathers are bosses, employers or business owners have the highest father-child correlations, relative to the rest of the occupations. Given that these last occupations are usually associated with a high socioeconomic status, this result reinforces our previous finding that children living in households with a higher socioeconomic level tend to experience a higher degree of paternal transmission. In the last specification of Table 9 (column 4), we allow for crossed effects between the father's occupation and the size of the maternal transmission. We see that children of agricultural workers also tend to have lower maternal transmission coefficients in comparison with the rest of the occupations. However, the paternal occupations that have a boosting effect on the maternal transmission are completely different from the ones that tended to enhance the strength of the paternal correlation. In this case, children of fathers who are family workers are the ones that seem to experience the highest level of maternal transmission.

Next, we analyze the size of the maternal transmission across the distribution of the mother's level of education and work status (Table 10). We notice that, on average, the size of the maternal transmission is lower for children whose mothers have educational levels that are higher or lower than high school; however these differences are not significant (just as in the case of the fathers, analyzed previously). Interestingly, the fact that a mother works does have a significant effect on the child's anthropometric status. As shown in column (3), children of working mothers are, on average, 0.087 standard deviations heavier in comparison with children of non-working mothers, and this effect is significant at 5 percent. In column (4) we introduce an interaction term to investigate the effect of the mother's working status on the size of her transmission coefficient. We find that, on average, having a working mother has a boosting effect on the size of the maternal transmission and this effect is significant at 10 percent (columns (4) and (5)). This result might be reflecting the fact that having a job actually gives the mother some economic and bargaining power that allow her to choose the children´s meals, which are likely to be compatible with her own preferences.

Finally, we study the effect of household size on the strength of the parental transmission. In theory, a child living in a small household should be more prone to experiment some degree of parental transmission since the interaction with the parents is more direct and, in some cases, the parents might be their only behavioral and environmental influence. Inversely, a child living in a large household is also subject to a number of different influences from the rest of the family members, so the share of the child's BMI that is explained exclusively by the parental transmission might not be as high in this case. In order to analyze this matter, we create interaction terms between the parental BMI and the size of the household, as shown in Table 11. The fist fact we notice is that the effect of the household size on the parental transmission is different for mothers and fathers. In the case of the mother-child relationship we notice that, although there is a very small and positive correlation between the size of the household and the strength of the transmission, this effect is not statistically significant. However, the father-child link does seem to respond significantly to changes in the household size. As shown in columns (1) and (3), an increase of one person in the household size is associated with a reduction of 0.027 points in the size of the father-child transmission, this effect being significant at 1 percent.

4.3.3 Parental anthropometric situation

Our next step is to find out whether the size of the parental transmission can also be influenced by the anthropometric situation of the parents themselves. For example, we want to know if obese parents are more or less prone to transmit their condition than the rest of the population. Table 12 shows the results of including interaction terms indicating whether the parents suffer from obesity, overweight, risk of overweight, or if they are malnourished or severely malnourished; taking normal weight parents as the base category[21].

The sign of the interaction terms shown in column (1) and (3) suggests that mothers with some degree of overweight or obesity are slightly more prone to transmit their anthropometric condition to their children, with respect to normal weight mothers; nevertheless, none of these differences is statistically significant. Interestingly, we also notice that severely underweight mothers tend to have a lower transmission than the ones with normal weight, and this effect is significant at 1 percent. However, given the small number of cases in this category one should be cautious when generalizing this particular result (see Table 3(c)).

Regarding the paternal link we also notice a higher strength of the transmission for those children whose fathers are obese or overweight, with respect to children of fathers with normal weight (columns (2) and (3)). However, unlike the mother´s case, these differences are significant at 5 percent. Since the process of genetic allocation is assumed to be the same to all the individuals regardless of their anthropometric condition, these results suggest that obese and overweight parents tend to have specific behaviors and provide their children with certain environment that somehow reinforce the transmission of their own condition.

5. Conclusions

In this paper we study the intergenerational transmission of the Body Mass Index (BMI) from parents to children using panel data from the Mexican Family Life Survey (MxFLS) 2002, 2005 and 2009. Departing from a simple model specification using ordinary least squares (OLS) and then applying fixed effects methodologies at the household and individual level, we have estimated a set of measures of the intergenerational transmission of the BMI between children and adolescents between 0 and 19 years old and their parents. Additionally, we analyzed the sensitivity of this estimate to the child's age and gender, the household socioeconomic characteristics and the anthropometric status of both parents.

[21] We have used the WHO classification for z-scores. The document containing this information can be found at: http://www.who.int/childgrowth/training/module_c_interpreting_indicators.pdf

According to our results, there is a strong positive correlation between the BMI of parents and children, which is driven by a mix of genetic, environmental and behavioral influences. We find that the significance of the mother-child correlation holds after controlling for household fixed-effects (eventually falling down as we control for the household socioeconomic status). Then, when we apply individual fixed-effects the statistical significance of the maternal link completely disappears. Conversely, the paternal link is resistant to the consideration of both household and individual fixed-effects, suggesting that, unlike the mother-child relationship, the strength of the paternal link lies in factors that go beyond a simple genetic correlation or the presence of shared family habits and other time-invariant characteristics. In terms of the size of the parental transmission, we notice that children tend to experience a higher degree of BMI transmission from the parent of the same sex, which might be due to the presence of a role modelling process. Regarding the effect of age, we find that as children grow up their anthropometric statuses resemble the ones of their parents in a more noticeable way, however this positive marginal effect is not constant across the distribution of the child's age. Also, the age groups that tend to experience a higher degree of parental transmission are not the same for the mother and the father. Socioeconomic status also seems to have an important effect on the size of the parental transmission. Specifically, we find that the father-child link in BMI tends to be particularly stronger for those households in the higher tail of the income distribution and for children whose fathers work as patrons, employers or business owners. These results might be suggesting that, in general, having a higher socioeconomic status makes fathers more able to choose their children's food and habits, so these are more compatible with their own. An analogous rationale is valid in the case of the maternal link, as we found that, on average, children of working mothers tend to experience a higher degree of maternal transmission in comparison with children of mothers who do not work. In this case, the fact that a mother works might be providing her with economic and bargaining power that makes her more able to choose the child's meals, which will be more compatible with her own preferences and choices. Also, we notice that the strength of the father-child link seems to weaken as the household grows in size, suggesting that the marginal effect of the father´s influence on the child´s BMI decreases as the child has additional behavioral and environmental influences inside the household. Finally, we find that both parental correlations tend to be higher for children whose parents are obese and overweight, and this effect is especially significant for the father-child relationship. These results suggest the presence of obesity-enhancing behaviors that reinforce this problem and make children more prone to inherit these anthropometric statuses, in comparison with the extent to which parents with normal weight would transmit their condition to their children.

The presence of an intergenerational transmission process in the BMI has multiple implications in terms of public health policy. Specifically, the fact that at least 20 and 40 percent of the maternal and paternal transmission, respectively, cannot be explained by genetic factors suggests that a child being obese or overweight is not an inevitable consequence of the genetic endowment provided by the parents, and consequently there is still room for external interventions that exploit the intergenerational nature of the problem. The recently published Mexican National Strategy for the Prevention and Control of Overweight and Diabetes, considers a set of policies in terms of public health, medical care and sanitary regulations, which are expected to promote a healthy lifestyle that includes a balanced diet and regular exercise. For the case of children, most of these policies focus on the availability of junk food in schools and the discouragement of its consumption by restricting junk food advertising during children's television programs. However, it is important to keep in mind that the quality of food that children consume is not only a function of their own preferences and the influences they receive at school or through the media, but also has to do with their parents' habits and information. In this regard, it is likely that restricting the contents of sugar and fat of the snacks and drinks sold at school or increasing the availability of natural water in public spaces will not have very strong effects in child obesity reduction if children still have access to high-calorie snacks and sugary drinks provided by the parents at home. Likewise, restricting junk food advertising during children's television programs is not likely to be very effective if the parents are exposed to the advertising and end up getting unhealthy food that soon becomes available for everyone in the household.

Following this reasoning, we consider that the best policies against child obesity and overweight are those that also attempt to modify the parents' behaviors and preferences. In this regard, Mexico's strategy against overweight and obesity also contains a set of policies focused on increasing the amount of nutritional information displayed in the labels of processed foods and drinks. According to these new regulations, all labels should contain the total caloric content of the product, decomposing the amount of calories that come from added sugars, other carbohydrates, saturated and unsaturated fat, proteins and sodium. Additionally, food producers will be also given the option to include a "nutritional badge" or classification label in their products which will allow people to easily identify the food group to which that particular meal or drink belongs to (vegetable oils and fats, fruits and vegetables, meat products, diary, etc). If parents have access to more information on the contents of the food they buy for the household and this has an effect in their own habits, children will eventually change their habits too (due to the lack of availability of junk food at home and the fact that they perceive that their parents are eating healthier now so they might want to do it as well, due to behavioral imitation). Similarly, policies aimed to increase the level of physical activity of children at school should be complemented with community activities and projects that also involve the participation of the parents, who should be encouraged to promote an active lifestyle for their children at home.

TABLES

SECTION A. Summary statistics

Table 1. Number of observations per year.

Year	Observations	Percent	Cumulative
Total number of children in the sample			
2002	10,523	34.83	34.83
2005	9,744	32.26	67.09
2009	9,942	32.91	100
Total	30,209	100	
Mother-child pairs			
2002	9,061	40.61	40.61
2005	6,347	28.44	69.05
2009	6,906	30.95	100
Total	22,314	100	
Father-child pairs			
2002	6,275	40.87	40.87
2005	4,340	28.27	69.14
2009	4,739	30.86	100
Total	15,354	100	
Mother-father-child sets			
2002	5,996	42.32	42.32
2005	4,047	28.56	70.88
2009	4,126	29.12	100
Total	14,169	100	

Table 2. Number of times each observation appears in the panel.

Number of waves	Observations	Percent	Cum.
1	8,622	28.54	28.54
2	11,066	36.63	65.17
3	10,521	34.83	100
Total	30,209	100	

Table 3(a). Anthropometric measures (pooled sample).

	Obs	Mean	Std. Dev.	Min	Max
Mother					
Age	22,304	36.63	8.09	16	63
Height (cms)	22,314	153.72	6.86	130.3	190
Weight (kgs)	22,314	67.40	13.65	31.6	135.5
BMI z-score	22,314	1.62	1.08	-3.94	4.99
Father					
Age	15,354	40.68	9.44	16	99
Height (cms)	15,354	166.22	7.16	140.1	199
Weight (kgs)	15,354	76.49	13.85	35.4	147
BMI z-score	15,354	1.41	1.03	-4.74	4.93
Child					
Age	30,209	10.28	5.36	0	19
Height (cms)	30,209	134.35	27.22	45.7	195.2
Weight (kgs)	30,209	38.47	20.36	2.7	132.5
BMI z-score	30,209	0.56	1.25	-4.99	5

Table 3(b). Anthropometric measures (panel)

	2002		2005		2009	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Mother						
Age	36.41	8.01	36.80	7.97	36.76	8.31
Height (cms)	153.31	6.86	154.21	6.94	153.81	6.77
Weight (kgs)	66.59	13.22	67.39	13.55	68.48	14.19
BMI z-score	1.59	1.05	1.58	1.09	1.70	1.09
Father						
Age	40.59	9.76	40.66	9.06	40.83	9.35
Height (cms)	165.79	7.23	166.57	7.13	166.45	7.05
Weight (kgs)	75.39	13.57	76.39	13.32	78.05	14.54
BMI z-score	1.35	1.03	1.38	1.02	1.51	1.02
Child						
Age	10.40	5.21	10.15	5.50	10.28	5.39
Height (cms)	134.61	26.29	133.52	28.75	134.87	26.63
Weight (kgs)	38.13	19.60	38.10	20.42	39.18	21.07
BMI z-score	0.51	1.16	0.54	1.36	0.64	1.23

Table 3 (c). Anthropometric classification: z-scores.

WHO classification for z-scores	*z-score range*	Mother Obs.	Mother %	Father Obs	Father %	Child Obs	Child %
Obese	z > 3	1,823	8.17	624	4.06	798	2.64
Overweight	3 ≥ z > 2	6,437	28.85	3,680	23.97	3,067	10.15
Possible risk of overweight	2 ≥ z > 1	8,178	36.65	6,323	41.18	6,427	21.28
Normal weight	1 ≥ z ≥ -2	5,823	26.10	4,662	30.36	19,334	64
Wasted (malnourished)	-2 > z ≥-3	39	0.17	39	0.25	406	1.34
Severely wasted (malnourished)	z < -3	14	0.06	26	0.17	177	0.59

SECTION B. Regression Tables[22]

Table 4 . Baseline model, OLS estimation[23].

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BMI z-score mother	0.268***		0.231***	0.240***	0.240***	0.247***	0.254***	0.255***	0.254***	0.254***
	(0.011)		(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
BMI z-score father		0.249***	0.211***	0.214***	0.214***	0.217***	0.215***	0.215***	0.213***	0.214***
		(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)
Child's gender: Male				0.055**	0.173***	0.176***	0.180***	0.180***	0.179***	0.181***
				(0.025)	(0.050)	(0.050)	(0.055)	(0.055)	(0.055)	(0.055)
Child´s age				-0.026***	-0.006	0.009	0.005	0.005	0.005	0.005
				(0.003)	(0.015)	(0.016)	(0.018)	(0.018)	(0.018)	(0.018)
Child's age squared					-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
					(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Gender (Male)*age					-0.011***	-0.011***	-0.011**	-0.011**	-0.011**	-0.011**
					(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Mother´s age						-0.013	-0.018	-0.018	-0.018	-0.017
						(0.015)	(0.017)	(0.017)	(0.017)	(0.017)
Father´s age						-0.028***	-0.021*	-0.020*	-0.021*	-0.022**
						(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
Mother's age squared						0.000	0.000	0.000	0.000	0.000
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Father's age squared						0.000**	0.000	0.000	0.000	0.000
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
WHO 2007 reference	0.101***	0.124***	0.071**	0.313***	0.271***	0.274***	0.325***	0.325***	0.328***	0.326***
	(0.022)	(0.027)	(0.028)	(0.037)	(0.053)	(0.053)	(0.059)	(0.059)	(0.058)	(0.058)
Constant	0.047*	0.110***	-0.182***	-0.142***	-0.241***	0.587**	0.536	0.508	0.548	0.547
	(0.025)	(0.029)	(0.035)	(0.038)	(0.062)	(0.235)	(0.429)	(0.431)	(0.434)	(0.425)
Household socioeconomic level							Y	Y	Y	Y
Region dummies								Y	Y	Y
Time dummies									Y	Y
Region*time interactions										Y
R-squared	0.057	0.046	0.087	0.092	0.093	0.096	0.108	0.108	0.109	0.110
N. of cases	22,314	15,354	14,169	14,169	14,169	14,166	11,065	11,065	11,065	11,065

[22] The stars in the estimated coefficients indicate their significance (*** p<0.01, ** p<0.05, * p<0.10), clustered standard errors by household in parenthesis.
[23] Household socioeconomic level includes the quantile of the household's income, size of the household, bedrooms per capita, father's occupation and mother's level of education.

Table 5. Household Fixed Effects

	(1)	(2)	(3)
BMI z-score mother	0.067**	0.047	0.045
	(0.030)	(0.039)	(0.040)
BMI z-score father	0.070**	0.073**	0.075**
	(0.028)	(0.036)	(0.035)
Child's gender: Male	0.138**	0.113*	0.115*
	(0.054)	(0.061)	(0.061)
Child´s age	0.019	0.014	0.012
	(0.017)	(0.019)	(0.019)
Child's age squared	-0.001**	-0.001*	-0.001*
	(0.001)	(0.001)	(0.001)
Gender (Male)*age	-0.011**	-0.007	-0.008
	(0.004)	(0.005)	(0.005)
Mother´s age	-0.040	-0.035	-0.033
	(0.029)	(0.038)	(0.039)
Father´s age	0.006	0.022	0.020
	(0.024)	(0.032)	(0.032)
Mother's age squared	0.001**	0.001	0.000
	(0.000)	(0.000)	(0.000)
Father's age squared	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
WHO 2007 reference	0.289***	0.332***	0.337***
	(0.053)	(0.060)	(0.060)
Constant	0.562	0.312	0.409
	(0.362)	(0.511)	(0.558)
Household socioeconomic level		Y	Y
Region dummies			Y
Time dummies			Y
Region*time interactions			Y
R-squared	0.017	0.020	0.023
N. of cases	14,166	11,065	11,065
N. of groups	3,928	3,284	3,284

Table 6. Individual Fixed Effects

	(1)	(2)	(3)
BMI z-score mother	0.052	0.043	0.035
	(0.033)	(0.041)	(0.041)
BMI z-score father	0.096***	0.089**	0.099***
	(0.032)	(0.039)	(0.038)
Child´s age	-0.011	-0.039	-0.104***
	(0.025)	(0.030)	(0.034)
Child's age squared	-0.002**	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Gender (Male)*age	0.001	0.004	0.004
	(0.006)	(0.007)	(0.007)
Mother´s age	0.010	0.017	0.011
	(0.034)	(0.043)	(0.042)
Father´s age	-0.009	0.009	-0.021
	(0.031)	(0.038)	(0.037)
Mother's age squared	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Father's age squared	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)
WHO 2007 reference	0.357***	0.483***	0.485***
	(0.067)	(0.078)	(0.078)
Constant	-0.280	0.144	4.251***
	(0.592)	(0.734)	(0.932)
Household socioeconomic level		Y	Y
Region dummies			Y
Time dummies			Y
Region*time interactions			Y
R-squared	0.039	0.051	0.061
N. of cases	14,166	11,065	11,065
N. of groups	9,124	7,459	7,459

Table 7. Variation in the size of the transmission elasticity: Child's characteristics

Table 7 (a). Child's gender

	(1)	(2)
BMI z-score mother	0.254***	0.272***
	(0.015)	(0.020)
BMI z-score father	0.213***	0.198***
	(0.016)	(0.019)
Child´s age	-0.017***	-0.017***
	(0.005)	(0.005)
Child's gender: Male	0.181***	0.189***
	(0.055)	(0.069)
Gender (Male)*Age	-0.011**	-0.010**
	(0.005)	(0.005)
Interaction terms:		
Gender:		
BMI z-score mother* Child's gender (male)		-0.035
		(0.024)
BMI z-score father* Child's gender (male)		0.030
		(0.026)
Mother's age, father's age and their squared terms	Y	Y
Household socioeconomic level	Y	Y
Region/ time dummies and their interactions	Y	Y
Constant and WHO 2007 reference dummy	Y	Y
R-squared	0.110	0.111
N. of cases	11065	11065

Table 7 (b). Child's age

	(1)	(2)	(3)	(4)
BMI z-score mother	0.206***	0.202***	0.255***	0.182***
	(0.030)	(0.030)	(0.015)	(0.026)
BMI z-score father	0.136***	0.134***	0.214***	0.132***
	(0.030)	(0.030)	(0.016)	(0.027)
Child´s age	-0.038***	-0.009		
	(0.007)	(0.018)		
Child's age squared		-0.001*		
		(0.001)		
Child's gender: Male	0.185***	0.186***	0.117**	0.122**
	(0.055)	(0.055)	(0.050)	(0.050)
Gender (Male)*Age	-0.012**	-0.012**		
	(0.005)	(0.005)		
Child's age group: 6-11 years old			0.170***	0.130
			(0.045)	(0.082)
Child's age group: 12-14 years old			0.151***	0.127
			(0.043)	(0.079)
Child's age group: 15-19 years old			0.000	0.000
			(.)	(.)
Gender (Male)*Child's age group: 6-11			-0.022	-0.026
			(0.063)	(0.062)
Gender (Male)* Child's age group: 12-14			-0.035	-0.040
			(0.069)	(0.069)
Gender (Male)*Child's age group: 15-19			-0.138**	-0.145**
			(0.066)	(0.066)
Age as a continous variable:				
BMI z-score mother * Child's age	0.005*	0.005**		
	(0.003)	(0.003)		
BMI z-score father * Child's age	0.008***	0.008***		
	(0.003)	(0.003)		
Age in categories (Base category: 0-5 years)				
BMI z-score mother * Child's age group: 6-11 years old				0.101***
				(0.032)
BMI z-score mother * Child's age group: 12-14 years old				0.110***
				(0.035)
BMI z-score mother * Child's age group: 15-19 years old				0.077**
				(0.038)
BMI z-score father * Child's age group: 6-11 years old				0.118***
				(0.034)
BMI z-score father * Child's age group: 12-14 years old				0.090**
				(0.037)
BMI z-score father * Child's age group: 15-19 years old				0.112***
				(0.036)
Mother's age, father's age and their squared terms	Y	Y	Y	Y
Household socioeconomic level	Y	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y	Y
R-squared	0.112	0.112	0.112	0.115
N. of cases	11065	11065	11065	11065

Table 7 (c). Child's age and gender

	(1)	(2)	(3)
BMI z-score mother	0.223***	0.219***	0.200***
	(0.032)	(0.033)	(0.029)
BMI z-score father	0.122***	0.121***	0.117***
	(0.033)	(0.033)	(0.030)
Child´s age	-0.038***	-0.010	
	(0.007)	(0.018)	
Child's age squared		-0.001*	
		(0.001)	
Child's gender: Male	0.193***	0.194***	0.132**
	(0.069)	(0.069)	(0.066)
Gender (Male)*Age	-0.011**	-0.011**	
	(0.005)	(0.005)	
Child's age group: 6-11 years old			0.133
			(0.082)
Child's age group: 12-14 years old			0.129
			(0.079)
Child's age group: 15-19 years old			0.000
			(.)
Gender (Male)*Child's age group: 6-11			-0.025
			(0.062)
Gender (Male)* Child's age group: 12-14			-0.035
			(0.069)
Gender (Male)*Child's age group: 15-19			-0.138**
			(0.067)
Interaction terms:			
Gender:			
BMI z-score mother* Child's gender (male)	-0.034	-0.034	-0.034
	(0.024)	(0.024)	(0.024)
BMI z-score father* Child's gender (male)	0.028	0.028	0.029
	(0.026)	(0.026)	(0.026)
Age as a continous variable:			
BMI z-score mother * Child's age	0.005*	0.005**	
	(0.003)	(0.003)	
BMI z-score father * Child's age	0.008***	0.008***	
	(0.003)	(0.003)	
Age in categories (Base category: 0-5 years)			
BMI z-score mother * Child's age group: 6-11 years old			0.100***
			(0.032)
BMI z-score mother * Child's age group: 12-14 years old			0.109***
			(0.035)
BMI z-score mother * Child's age group: 15-19 years old			0.077**
			(0.038)
BMI z-score father * Child's age group: 6-11 years old			0.118***
			(0.034)
BMI z-score father * Child's age group: 12-14 years old			0.090**
			(0.037)
BMI z-score father * Child's age group: 15-19 years old			0.111***
			(0.036)
Mother's age, father's age and their squared terms	Y	Y	Y
Household socioeconomic level	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y
R-squared	0.112	0.113	0.115
N. of cases	11065	11065	11065

Table 8. Variation in the size of the parental transmission: Quantile of Household Income

	(1)	(2)	(3)
BMI z-score mother	0.250***	0.254***	0.257***
	(0.031)	(0.015)	(0.030)
BMI z-score father	0.213***	0.173***	0.173***
	(0.016)	(0.032)	(0.032)
Quantile of Household Income			
2nd Quantile	0.026	-0.021	0.021
	(0.078)	(0.067)	(0.089)
3rd Quantile	-0.047	-0.083	-0.095
	(0.075)	(0.071)	(0.090)
4th Quantile	0.022	-0.084	-0.098
	(0.078)	(0.071)	(0.092)
Interaction terms:			
BMI z-score mother * 2nd Quantile	-0.028		-0.031
	(0.041)		(0.041)
BMI z-score mother * 3rd Quantile	0.015		0.008
	(0.037)		(0.037)
BMI z-score mother *4th Quantile	0.024		0.009
	(0.039)		(0.039)
BMI z-score father * 2nd Quantile		-0.001	0.004
		(0.041)	(0.041)
BMI z-score father * 3rd Quantile		0.042	0.041
		(0.040)	(0.040)
BMI z-score father *4th Quantile		0.096**	0.094**
		(0.039)	(0.040)
Child's age, mother's age, father's age and their squared terms	Y	Y	Y
Household socioeconomic level	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y
R-squared	0.111	0.111	0.112
N. of cases	11,065	11,065	11,065

Table 9. Variation in the size of the parental transmission: Father's occupation

	(1)	(2)	(3)	(4)
BMI z-score mother	0.254***	0.258***	0.258***	0.178***
	(0.015)	(0.015)	(0.016)	(0.067)
BMI z-score father	0.138***	0.256***	0.173***	0.189***
	(0.036)	(0.046)	(0.063)	(0.065)
Father's occupation (Base category: Agricultural worker)				
Peasant own plot	-0.090		-0.069	-0.098
	(0.092)		(0.099)	(0.131)
Family worker	-0.055		-0.051	-0.351
	(0.160)		(0.163)	(0.223)
Non-agricultural worker/employee	-0.095		-0.104	-0.245**
	(0.069)		(0.073)	(0.097)
Boss, employer or business owner	-0.134		-0.166	-0.259
	(0.132)		(0.140)	(0.165)
Freelancer	-0.071		-0.077	-0.267**
	(0.083)		(0.087)	(0.117)
Informal worker	-0.413**		-0.353*	-0.336
	(0.186)		(0.183)	(0.230)
Father's education (Base category: High school)				
Less than High school		0.005	0.009	0.009
		(0.050)	(0.051)	(0.051)
More than High school		-0.053	-0.049	-0.046
		(0.068)	(0.069)	(0.069)
Interaction Terms : Father's occupation				
BMI z-score father * Peasant own plot	0.120**		0.110*	0.101*
	(0.056)		(0.060)	(0.060)
BMI z-score father * Family worker	0.099		0.097	0.068
	(0.085)		(0.086)	(0.086)
BMI z-score father * Non-agricultural worker/employee	0.073*		0.077*	0.059
	(0.041)		(0.044)	(0.044)
BMI z-score father * Boss, employer or business owner	0.153*		0.172**	0.158*
	(0.078)		(0.083)	(0.084)
BMI z-score father * Freelancer	0.087*		0.101**	0.079
	(0.049)		(0.051)	(0.052)
BMI z-score father * Informal worker	0.196*		0.150	0.153
	(0.115)		(0.119)	(0.124)
BMI z-score mother * Peasant own plot				0.029
				(0.055)
BMI z-score mother * Family worker				0.202**
				(0.093)
BMI z-score mother * Non-agricultural worker/employee				0.101**
				(0.044)
BMI z-score mother * Boss, employer or business owner				0.068
				(0.061)
BMI z-score mother * Freelancer				0.134**
				(0.054)
BMI z-score mother * Informal worker				0.002
				(0.120)
Interaction Terms : Father's education				
BMI z-score father * Less than high school		-0.045	-0.035	-0.036
		(0.048)	(0.049)	(0.051)
BMI z-score father * More than high school		-0.068	-0.066	-0.064
		(0.086)	(0.088)	(0.092)
BMI z-score mother * Less than high school				-0.002
				(0.055)
BMI z-score mother * More than high school				-0.045
				(0.081)
Child's age, mother's age, father's age and their squared terms	Y	Y	Y	Y
Household socioeconomic level	Y	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y	Y
R-squared	0.111	0.108	0.113	0.115
N. of cases	11,065	11,093	10,573	10,573

Table 10. Variation in the size of the parental transmission: Mother's education and work status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BMI z-score mother	0.254***	0.279***	0.244***	0.232***	0.232***	0.262***	0.256***
	(0.015)	(0.051)	(0.015)	(0.016)	(0.016)	(0.053)	(0.054)
BMI z-score father	0.215***	0.215***	0.204***	0.204***	0.205***	0.214***	0.253***
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)	(0.049)
Mother's education (Base category: High school)							
Less than high school	-0.149***	-0.104				-0.111	-0.054
	(0.057)	(0.100)				(0.101)	(0.119)
More than high school	-0.105	-0.058				-0.056	0.013
	(0.086)	(0.146)				(0.145)	(0.183)
Mother's work status							
Mother works			0.087**	-0.001	-0.000	-0.017	-0.009
			(0.034)	(0.064)	(0.077)	(0.066)	(0.081)
Interaction terms : Mother's education							
BMI z-score mother * Less than high school		-0.028				-0.020	-0.013
		(0.053)				(0.053)	(0.055)
BMI z-score mother * More than high school		-0.031				-0.042	-0.034
		(0.079)				(0.079)	(0.082)
BMI z-score father * Less than high school							-0.041
							(0.050)
BMI z-score father * More than high school							-0.051
							(0.090)
Interaction terms : Mother's work status							
BMI z-score mother * Mother works				0.053*	0.053*	0.052	0.053
				(0.031)	(0.031)	(0.032)	(0.032)
BMI z-score father * Mother works					-0.001		-0.006
					(0.031)		(0.033)
Child's age, mother's age, father's age and their squared terms	Y	Y	Y	Y	Y	Y	Y
Household socioeconomic level	Y	Y	Y	Y	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y	Y	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y	Y	Y	Y	Y
R-squared	0.110	0.110	0.108	0.108	0.108	0.111	0.111
N. of cases	11065	11065	12123	12123	12123	11063	11063

Table 11. Variation in the size of the parental transmission: Size of the household

	(1)	(2)	(3)
BMI z-score mother	0.253***	0.255***	0.226***
	(0.044)	(0.015)	(0.043)
BMI z-score father	0.214***	0.365***	0.371***
	(0.016)	(0.048)	(0.048)
Size Household	-0.027**	0.012	0.005
	(0.014)	(0.013)	(0.016)
Interaction terms			
BMI z-score mother * Size household	0.000		0.005
	(0.007)		(0.007)
BMI z-score father * Size household		-0.026***	-0.027***
		(0.008)	(0.008)
Child's age, mother's age, father's age and their squared terms	Y	Y	Y
Household socioeconomic level	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y
R-squared	0.110	0.112	0.112
N. of cases	11,065	11,065	11,065

Table 12. Variation in the size of the parental transmission: Parental anthropometric status

	(1)	(2)	(3)
BMI z-score mother	0.189***	0.254***	0.191***
	(0.050)	(0.015)	(0.050)
BMI z-score father	0.212***	0.116***	0.119***
	(0.016)	(0.044)	(0.044)
Interaction terms (Base category: Normal weight)			
BMI z-score mother * Obese mother	0.059		0.056
	(0.048)		(0.048)
BMI z-score mother * Overweight mother	0.069		0.067
	(0.047)		(0.047)
BMI z-score mother * Possible risk of overweight mother	0.025		0.024
	(0.045)		(0.045)
BMI z-score mother * Wasted (malnourished) mother	0.105		0.104
	(0.182)		(0.183)
BMI z-score mother * Severely wasted (malnourished) mother	-0.274***		-0.240***
	(0.086)		(0.091)
BMI z-score father * Obese father		0.114**	0.108**
		(0.047)	(0.047)
BMI z-score father* Overweight father		0.094**	0.089**
		(0.042)	(0.043)
BMI z-score father* Possible risk of overweight father		0.060	0.057
		(0.042)	(0.042)
BMI z-score father * Wasted (malnourished) father		0.094	0.094
		(0.091)	(0.091)
BMI z-score father * Severely wasted (malnourished) father		0.082	0.083
		(0.093)	(0.092)
Child's age, mother's age, father's age and their squared terms	Y	Y	Y
Household socioeconomic level	Y	Y	Y
Region/ time dummies and their interactions	Y	Y	Y
Constant and WHO 2007 reference dummy	Y	Y	Y
R-squared	0.112	0.112	0.113
N. of cases	11,065	11,065	11,065

FIGURES

Figure 1. Distribution of the BMI z-scores .- Kernel density by group.

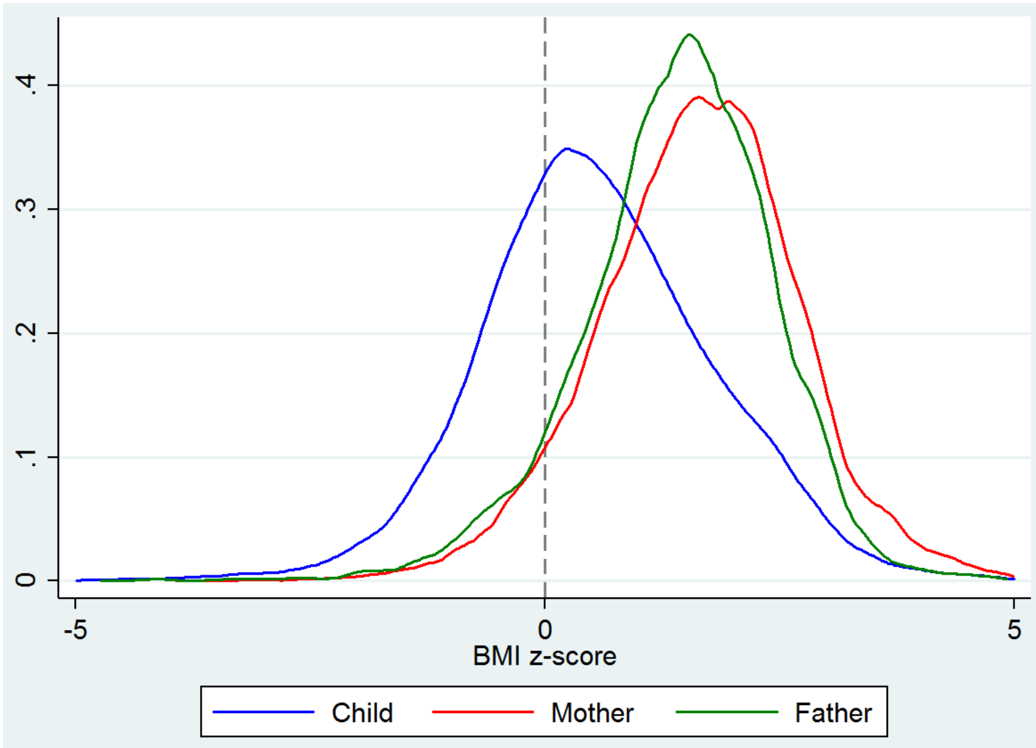

Figure 2. Distribution of the BMI z-scores .- Kernel density by year

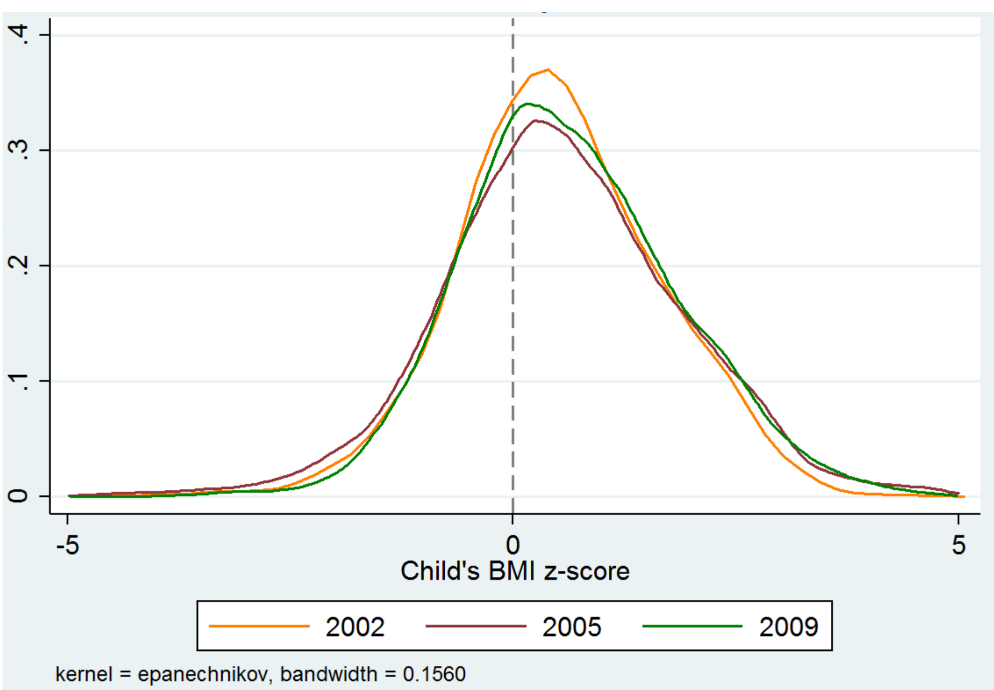

Figure 3. Map of Regions in Mexico (Following the classification used by the Bank of Mexico for its Quarterly Reports of Regional Economies).

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APPENDIX

Table A1. Description of variables.

Variable	Description
BMI z-score mother	BMI z-score of the child's mother, according to the WHO standards.
BMI z-score father	BMI z-score of the child's father, according to the WHO standards.
Child's age and gender:	
Child's gender: Male	Dummy variable that It takes the value of 1 for male children and 0 for female children.
Child's age	Age of the child, in years.
Child's age squared	Square of the child's age, in years.
Gender (Male) * age	Interaction term between the child's gender and age. It takes the value of the child's age only for male children.
Child's age group: 0-5 years old (base category)	Dummy variable taking the value of 1 if the child's age is between 0 and 5 years, 0 otherwise.
Child's age group: 6-11 years old	Dummy variable taking the value of 1 if the child's age is between 6 and 11 years, 0 otherwise.
Child's age group: 12-14 years old	Dummy variable taking the value of 1 if the child's age is between 12 and 14 years, 0 otherwise.
Child's age group: 15-19 years old	Dummy variable taking the value of 1 if the child's age is between 15 and 19 years, 0 otherwise.
Gender (Male)*Child's age group: 0-5 (base category	Interaction term between the child's gender and age group. It takes the value of 1 only for male children between 0 and 5 years.
Gender (Male)*Child's age group: 6-11	Interaction term between the child's gender and age group. It takes the value of 1 only for male children between 6 and 11 years.
Gender (Male)* Child's age group: 12-14	Interaction term between the child's gender and age group. It takes the value of 1 only for male children between 12 and 14 years.
Gender (Male)*Child's age group: 15-19	Interaction term between the child's gender and age group. It takes the value of 1 only for male children between 15 and 19 years.
BMI z-score mother* Child's gender (male)	Interaction term between the child's gender and the mother's BMI z-score. It takes the value of the mother's z-score only for male children (0 for females).
BMI z-score father* Child's gender (male)	Interaction term between the child's gender and the father's BMI z-score. It takes the value of the father's z-score only for male children (0 for females).
BMI z-score mother * Child's age	Interaction term between the child's age and the mother's BMI z-score. It takes the value of the result of the multiplying the child's age (in years) and the mother's BMI z-score.
BMI z-score father * Child's age	Interaction term between the child's age and the father's BMI z-score. It takes the value of the result of the multiplying the child's age (in years) and the father's BMI z-score.
BMI z-score mother * Child's age group: 0-5 years old (base category)	Interaction term between the dummy variable for the child's age group (0-5 years) and the mother's BMI z-score. It takes the value of the mother's z-score only for children between 0 and 5 years old.
BMI z-score mother * Child's age group: 6-11 years old	Interaction term between the dummy variable for the child's age group (6-11 years) and the mother's BMI z-score. It takes the value of the mother's z-score only for children between 6 and 11 years old.

BMI z-score mother * Child's age group: 12-14 years old	Interaction term between the dummy variable for the child's age group (12-14 years) and the mother's BMI z-score. It takes the value of the mother's z-score only for children between 12 and 14 years old.
BMI z-score mother * Child's age group: 15-19years old	Interaction term between the dummy variable for the child's age group (15-19 years) and the mother's BMI z-score. It takes the value of the mother's z-score only for children between 15 and 19 years old.
BMI z-score father * Child's age group: 0-5 years old (base category)	Interaction term between the dummy variable for the child's age group (0-5 years) and the father's BMI z-score. It takes the value of the father's z-score only for children between 0 and 5 years old.
BMI z-score father * Child's age group: 6-11 years old	Interaction term between the dummy variable for the child's age group (6-11 years) and the father's BMI z-score. It takes the value of the father's z-score only for children between 6 and 11 years old.
BMI z-score father * Child's age group: 12-14 years old	Interaction term between the dummy variable for the child's age group (12-14 years) and the father's BMI z-score. It takes the value of the father's z-score only for children between 12 and 14 years old.
BMI z-score father * Child's age group: 15-19 years old	Interaction term between the dummy variable for the child's age group (15-19 years) and the father's BMI z-score. It takes the value of the father's z-score only for children between 15 and 19 years old.
Mother's age	Age of the child's mother, in years.
Father's age	Age of the child's father, in years.
Mother's age squared	Square of the mother's age, in years.
Father's age squared	Square of the father's age, in years.
WHO 2007 reference	Dummy variable taking the value of 1 if the z-score of the child was calculated using the 2007 WHO standards, 0 if it was calculated using the 2006 WHO standards.
Quantile of Household Income	
1st Quantile (Base cateogry)	Dummy variable taking the value of 1 if the sum of total income received by all family members is in the 1st quantile of the sample's income distribution, 0 otherwise.
2nd Quantile	Dummy variable taking the value of 1 if the sum of total income received by all family members is in the 2nd quantile of the sample's income distribution, 0 otherwise.
3rd Quantile	Dummy variable taking the value of 1 if the sum of total income received by all family members is in the 3rd quantile of the sample's income distribution, 0 otherwise.
4th Quantile	Dummy variable taking the value of 1 if the sum of total income received by all family members is in the 4th quantile of the sample's income distribution, 0 otherwise.
BMI z-score mother * 1st Quantile (Base category)	Interaction term between the dummy variable for the 1st quantile of household income and the mother's BMI z-score. It takes the value of the mother's z-score only for children in households in the 1st quantile of the income distribution.
BMI z-score mother * 2nd Quantile	Interaction term between the dummy variable for the 2nd quantile of household income and the mother's BMI z-score. It takes the value of the mother's z-score only for children in households in the 2nd quantile of the income distribution.
BMI z-score mother * 3rd Quantile	Interaction term between the dummy variable for the 3rd quantile of household income and the mother's BMI z-score. It takes the value of the mother's z-score only for children in households in the 3rd quantile of the income distribution.

BMI z-score mother *4th Quantile	Interaction term between the dummy variable for the 4th quantile of household income and the mother's BMI z-score. It takes the value of the mother's z-score only for children in households in the 4th quantile of the income distribution.
BMI z-score father * 1st Quantile (Base category)	Interaction term between the dummy variable for the 1st quantile of household income and the father's BMI z-score. It takes the value of the father's z-score only for children in households in the 1st quantile of the income distribution.
BMI z-score father * 2nd Quantile	Interaction term between the dummy variable for the 2nd quantile of household income and the father's BMI z-score. It takes the value of the father's z-score only for children in households in the 2nd quantile of the income distribution.
BMI z-score father * 3rd Quantile	Interaction term between the dummy variable for the 3rd quantile of household income and the father's BMI z-score. It takes the value of the father's z-score only for children in households in the 3rd quantile of the income distribution.
BMI z-score father *4th Quantile	Interaction term between the dummy variable for the 4th quantile of household income and the father's BMI z-score. It takes the value of the father's z-score only for children in households in the 4th quantile of the income distribution.
Size of the household	Number of individuals living in the child's household.
BMI z-score mother * Size household	Interaction term between the size of the household and the mother's BMI z-score. It takes the value of the result of multiplying the number of individuals in the household by the mother's BMI z-score.
BMI z-score father * Size household	Interaction term between the size of the household and the father's BMI z-score. It takes the value of the result of multiplying the number of individuals in the household by the father's BMI z-score.
Bedrooms per capita	Number of bedrooms in the house where the child lives divided by the number of people living in the household.
Father's Occupation:	
Agricultural worker (Base category)	Dummy variable taking the value of 1 if the child's father is an agricultural worker (rural laborer or farmhand), 0 otherwise.
Peasant own plot	Dummy variable taking the value of 1 if the child's father is peasant on his own plot , 0 otherwise.
Family worker	Dummy variable taking the value of 1 if the child's father is a family worker without remuneration from a business owned by the household, 0 otherwise.
Non-agricultural worker/employee	Dummy variable taking the value of 1 if the child's father is a non-agricultural worker or employee, 0 otherwise.
Boss, employer or business owner	Dummy variable taking the value of 1 if the child's father is the patron/boss, employer or owner of a business, 0 otherwise.
Freelancer	Dummy variable taking the value of 1 if the child's father is an independent/self-employed worker, 0 otherwise.
Informal worker	Dummy variable taking the value of 1 if the child's father is a worker without remuneration from a business not owned by the household , 0 otherwise.
BMI z-score father * Agricultural worker (Base category)	Interaction term between the dummy variable for the father's occupation (agricultural worker) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are agricultural workers (0 otherwise).
BMI z-score father * Peasant own plot	Interaction term between the dummy variable for the father's occupation (peasant on his own plot) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are peasants on their own plot (0 otherwise).

BMI z-score father * Family worker	Interaction term between the dummy variable for the father's occupation (family worker) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are family workers (0 otherwise).
BMI z-score father * Non-agricultural worker/employee	Interaction term between the dummy variable for the father's occupation (non-agricultural worker/employee) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are agricultural employees (0 otherwise).
BMI z-score father * Boss, employer or business owner	Interaction term between the dummy variable for the father's occupation (boss, employer or business owner) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are bosses, employers or business owners (0 otherwise).
BMI z-score father * Freelancer	Interaction term between the dummy variable for the father's occupation (freelancer) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are freelancers (0 otherwise).
BMI z-score father * Informal worker	Interaction term between the dummy variable for the father's occupation (informal worker) and the father's BMI z-score. It takes the value of the father's BMI z-score only for children whose fathers are informal workers (0 otherwise).
BMI z-score mother * Agricultural worker (Base category)	Interaction term between the dummy variable for the father's occupation (agricultural worker) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are agricultural workers (0 otherwise).
BMI z-score mother * Peasant own plot	Interaction term between the dummy variable for the father's occupation (peasant on his own plot) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are peasants on their own plot (0 otherwise).
BMI z-score mother * Family worker	Interaction term between the dummy variable for the father's occupation (family worker) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are family workers (0 otherwise).
BMI z-score mother * Non-agricultural worker/employee	Interaction term between the dummy variable for the father's occupation (non-agricultural worker/employee) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are agricultural employees (0 otherwise).
BMI z-score mother * Boss, employer or business owner	Interaction term between the dummy variable for the father's occupation (boss, employer or business owner) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are bosses, employers or business owners (0 otherwise).
BMI z-score mother * Freelancer	Interaction term between the dummy variable for the father's occupation (freelancer) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are freelancers (0 otherwise).
BMI z-score mother * Informal worker	Interaction term between the dummy variable for the father's occupation (informal worker) and the mother's BMI z-score. It takes the value of the mother's BMI z-score only for children whose fathers are informal workers (0 otherwise).
Father's Education	
High school (Base category)	Dummy variable taking the value of 1 if the father's educational level is high school, 0 otherwise.
Less than high school	Dummy variable taking the value of 1 if the father's educational level is lower than high school (no education at all, preschool, primary, or secondary school), 0 otherwise.

More than High School	Dummy variable taking the value of 1 if the father's educational level is higher than high school (normal school, undergraduate degree, postgraduate degree), 0 otherwise.
BMI z-score father * High school (Base category)	Interaction term between the father's educational level dummy (high school) and the father's BMI z-score. It takes the value of the father's z-scores only for children whose fathers have an educational level of high school, 0 otherwise.
BMI z-score father * Less than high school	Interaction term between the father's educational level dummy (less than high school) and the father's BMI z-score. It takes the value of the father's z-scores only for children whose fathers have an educational level lower than high school, 0 otherwise.
BMI z-score father * More than high school	Interaction term between the father's educational level dummy (more than high school) and the father's BMI z-score. It takes the value of the father's z-scores only for children whose fathers have an educational level higher than high school, 0 otherwise.
BMI z-score mother * High school (Base category)	Interaction term between the father's educational level dummy (high school) and the mother's BMI z-score. It takes the value of the mother's z-scores only for children whose fathers have an educational level of high school, 0 otherwise.
BMI z-score mother * Less than high school	Interaction term between the father's educational level dummy (less than high school) and the mother's BMI z-score. It takes the value of the mother's z-scores only for children whose fathers have an educational level lower than high school, 0 otherwise.
BMI z-score mother * More than high school	Interaction term between the father's educational level dummy (more than high school) and the mother's BMI z-score. It takes the value of the mother's z-scores only for children whose fathers have an educational level higher than high school, 0 otherwise.
Mother's Education	
High school (Base category)	Dummy variable taking the value of 1 if the mother's educational level is high school, 0 otherwise.
Less than high school	Dummy variable taking the value of 1 if the mother's educational level is lower than high school (no education at all, preschool, primary, or secondary school), 0 otherwise.
More than High School	Dummy variable taking the value of 1 if the mother's educational level is higher than high school (normal school, undergraduate degree, postgraduate degree), 0 otherwise.
BMI z-score mother * High school (Base category)	Interaction term between the mother's educational level dummy (high school) and the mother's BMI z-score. It takes the value of the mother's z-scores only for children whose mothers have an educational level of high school, 0 otherwise.
BMI z-score mother * Less than high school	Interaction term between the mother's educational level dummy (less than high school) and the mother's BMI z-score. It takes the value of the mother's z-scores only for children whose mothers have an educational level lower than high school, 0 otherwise.
BMI z-score mother * More than high school	Interaction term between the mother's educational level dummy (more than high school) and the mother's BMI z-score. It takes the value of the mother's z-scores only for children whose mothers have an educational level higher than high school, 0 otherwise.
BMI z-score father * High school (Base category)	Interaction term between the mother's educational level dummy (high school) and the father's BMI z-score. It takes the value of the father's z-scores only for children whose mothers have an educational level of high school, 0 otherwise.
BMI z-score father * Less than high school	Interaction term between the mother's educational level dummy (less than high school) and the father's BMI z-score. It takes the value of the father's z-scores only for children whose mothers have an educational level lower than high school, 0 otherwise.
BMI z-score father * More than high school	Interaction term between the mother's educational level dummy (more than high school) and the father's BMI z-score. It takes the value of the father's z-scores only for children whose mothers

	have an educational level higher than high school, 0 otherwise.

Mother's working status	
Mother works	Dummy variable taking the value of 1 if the child's mother works (outside the household).
BMI z-score mother * Mother works	Interaction variable between the dummy indicating the mother's working status and the BMI z-score of the mother. It takes the value of the mother's z-score only for those children whose mothers work, 0 otherwise.
BMI z-score father * Mother works	Interaction variable between the dummy indicating the mother's working status and the BMI z-score of the father. It takes the value of the father's z-score only for those children whose mothers work, 0 otherwise.
Region dummies(*)	
North (Base category)	Dummy variable indicating whether the household is located in the north of the country. It takes the value of 1 for the following states: Baja California, Chihuahua, Coahuila, Nuevo Leon, Sonora, Tamualipas; 0 otherwise.
Center-North	Dummy variable indicating whether the household is located in the center-north of the country. It takes the value of 1 for the following states: Baja California Sur, Aguascalientes, Colima, Durango, Jalisco, Michoacan, Nayarit, San Luis Potosi, Sinaloa, Zacatecas; 0 otherwise.
Center	Dummy variable indicating whether the household is located in the center of the country. It takes the value of 1 for the following states: Distrito Federal, Estado de Mexico, Guanajauato, Hidalgo, Morelos, Puebla, Queretaro, Tlaxcala; 0 otherwise.
South	Dummy variable indicating whether the household is located in the south of the country. It takes the value of 1 for the following states: Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, Yucatan; 0 otherwise.
Time dummies	
2002 (Base category)	Dummy variable taking the value of 1 if the observation comes from the 2002 survey, 0 otherwise.
2005	Dummy variable taking the value of 1 if the observation comes from the 2005 survey, 0 otherwise.
2009	Dummy variable taking the value of 1 if the observation comes from the 2009 survey, 0 otherwise.
Region-Time Interactions	
2002-North (Base category)	Interaction term that takes the value of 1 if the observation comes from the 2002 survey in the north, 0 otherwise.
2002-Center	Interaction term that takes the value of 1 if the observation comes from the 2002 survey in the center-north, 0 otherwise.
2002-Center north	Interaction term that takes the value of 1 if the observation comes from the 2002 survey in the center, 0 otherwise.
2002-South	Interaction term that takes the value of 1 if the observation comes from the 2002 survey in the south, 0 otherwise.
2005-North (Base category)	Interaction term that takes the value of 1 if the observation comes from the 2005 survey in the north, 0 otherwise.
2005-Center	Interaction term that takes the value of 1 if the observation comes from the 2005 survey in the center-north, 0 otherwise.
2005-Center north	Interaction term that takes the value of 1 if the observation comes from the 2005 survey in the center, 0 otherwise.

2005-South	Interaction term that takes the value of 1 if the observation comes from the 2005 survey in the south, 0 otherwise.
2009-North (Base category)	Interaction term that takes the value of 1 if the observation comes from the 2009 survey in the north, 0 otherwise.
2009-Center	Interaction term that takes the value of 1 if the observation comes from the 2009 survey in the center-north, 0 otherwise.
2009-Center north	Interaction term that takes the value of 1 if the observation comes from the 2009 survey in the center, 0 otherwise.
2009-South	Interaction term that takes the value of 1 if the observation comes from the 2009 survey in the south, 0 otherwise.
Parental anthropometric status	
BMI z-score mother * Normal weight (Base category)	Interaction term between the WHO classification of the mother's BMI z-score (normal weight) and the level of the mother's BMI z-score. Takes the value of the mother's BMI z-score if the mother is classified as normal weight, 0 otherwise.
BMI z-score mother * Obese mother	Interaction term between the WHO classification of the mother's BMI z-score (obese) and the level of the mother's BMI z-score. Takes the value of the mother's BMI z-score if the mother is classified as obese, 0 otherwise.
BMI z-score mother * Overweight mother	Interaction term between the WHO classification of the mother's BMI z-score (overweight) and the level of the mother's BMI z-score. Takes the value of the mother's BMI z-score if the mother is classified as overweight, 0 otherwise.
BMI z-score mother * Possible risk of overweight mother	Interaction term between the WHO classification of the mother's BMI z-score (possible risk of overweight) and the level of the mother's BMI z-score. Takes the value of the mother's BMI z-score if the mother is classified as possible risk of overweight, 0 otherwise.
BMI z-score mother * Wasted (malnourished) mother	Interaction term between the WHO classification of the mother's BMI z-score (wasted) and the level of the mother's BMI z-score. Takes the value of the mother's BMI z-score if the mother is classified as wasted, 0 otherwise.
BMI z-score mother * Severely wasted (malnourished) mother	Interaction term between the WHO classification of the mother's BMI z-score (severely wasted) and the level of the mother's BMI z-score. Takes the value of the mother's BMI z-score if the mother is classified as severely wasted, 0 otherwise.
BMI z-score father * Normal weight (Base category)	Interaction term between the WHO classification of the father's BMI z-score (normal weight) and the level of the father's BMI z-score. Takes the value of the father's BMI z-score if the father is classified as normal weight, 0 otherwise.
BMI z-score father * Obese father	Interaction term between the WHO classification of the father's BMI z-score (obese) and the level of the father's BMI z-score. Takes the value of the father's BMI z-score if the father is classified as obese, 0 otherwise.
BMI z-score father* Overweight father	Interaction term between the WHO classification of the father's BMI z-score (overweight) and the level of the father's BMI z-score. Takes the value of the father's BMI z-score if the father is classified as overweight, 0 otherwise.
BMI z-score father* Possible risk of overweight father	Interaction term between the WHO classification of the father's BMI z-score (possible risk of overweight) and the level of the father's BMI z-score. Takes the value of the father's BMI z-score if the father is classified as possible risk of overweight, 0 otherwise.
BMI z-score father * Wasted (malnourished) father	Interaction term between the WHO classification of the father's BMI z-score (wasted) and the level of the father's BMI z-score. Takes the value of the father's BMI z-score if the father is classified as wasted, 0 otherwise.

BMI z-score father * Severely wasted (malnourished) father	Interaction term between the WHO classification of the father's BMI z-score (severely wasted) and the level of the father's BMI z-score. Takes the value of the father's BMI z-score if the father is classified as severely wasted, 0 otherwise.

(*)Classification used by the Bank of Mexico in their Reports of Regional Economies

Table A2. Individual Fixed Effects (restricted sample: children whose both parents work).

	(1)	(2)	(3)
BMI z-score mother	0.121	0.073	0.046
	(0.104)	(0.125)	(0.135)
BMI z-score father	0.069	0.082	0.085
	(0.078)	(0.078)	(0.082)
Child´s age	0.037	0.000	-0.032
	(0.079)	(0.083)	(0.078)
Child's age squared	-0.004	-0.003	-0.003
	(0.003)	(0.003)	(0.003)
Gender (Male)*age	0.019	0.027	0.025
	(0.023)	(0.024)	(0.024)
Mother´s age	-0.152	-0.216*	-0.248**
	(0.110)	(0.113)	(0.113)
Father´s age	0.159	0.239**	0.219*
	(0.107)	(0.121)	(0.116)
Mother's age squared	0.002	0.003**	0.003**
	(0.001)	(0.001)	(0.001)
Father's age squared	-0.002*	-0.003**	-0.002**
	(0.001)	(0.001)	(0.001)
WHO 2007 reference	0.395	0.503**	0.487**
	(0.240)	(0.249)	(0.246)
Constant	-0.235	-1.415	0.349
	(1.742)	(1.974)	(2.713)
Household socioeconomic level		Y	Y
Region dummies			Y
Time dummies			Y
Region*time interactions			Y
R-squared	0.080	0.118	0.131
N. of cases	2,749	2,589	2,589
N. of groups	2,323	2,184	2,184

Table A3. Household Fixed Effects (restricted sample: children whose both parents work).

	(1)	(2)	(3)
BMI z-score mother	0.180*	0.162	0.139
	(0.104)	(0.116)	(0.121)
BMI z-score father	0.033	-0.003	-0.036
	(0.073)	(0.074)	(0.081)
Child's gender: Male	0.100	0.051	0.053
	(0.137)	(0.139)	(0.139)
Child´s age	0.010	0.013	0.014
	(0.041)	(0.043)	(0.043)
Child's age squared	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
Gender (Male)*age	-0.002	0.002	0.002
	(0.011)	(0.011)	(0.011)
Mother´s age	-0.060	-0.106	-0.121
	(0.092)	(0.091)	(0.092)
Father´s age	0.067	0.128	0.136
	(0.100)	(0.104)	(0.105)
Mother's age squared	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Father's age squared	-0.001	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
WHO 2007 reference	0.304**	0.310**	0.310**
	(0.130)	(0.133)	(0.134)
Constant			
Household socioeconomic level		Y	Y
Region dummies			Y
Time dummies			Y
Region*time interactions			Y
R-squared	0.021	0.030	0.031
N. of cases	2,749	2,589	2,589
N. of groups	1,108	1,051	1,051