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DETERMINANTS OF THE PREVALENCE OF CHILHOOD OBESITY IN SPAIN: POLICY IMPLICATIONS

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Determinants of the Prevalence of Childhood Obesity in Spain: Policy Implications

Abstract

The prevalence of obesity among children in Spain, in 2012, was 9% while the overweight rate reached 26%. Concerns about childhood obesity have increased in the last years as some food habits tend to persist during children's life (cohort effect). This study aims at a better understanding of factors influencing the prevalence of obesity in Spain. Microdata from the last available National Health Survey (2012) is used. The methodological framework is based on the estimation of a Sample Selection Model. Results suggest that the prevalence of obesity increases as the children live in a household belonging to the higher social class as well as in households in which parents are obese. Lower childhood physical activity is positively related to the probability of being obese. The time spent playing videogames during weekends has a significant and positive association with the prevalence of obesity. Finally, there exists a positive relationship between children BMI and the inadequateness intake of fresh fruits, fish, pasta and rice, legumes, sweets and soft drinks.

1. Introduction

During the last few decades, food diets have transformed substantially as a result of multiple factors from which farm policies (including farms commodity programs (subsidies) and public agricultural research and development - R+D) (Alston et al., 2008) have played a pivotal role. In fact, such policies have contributed to the modernization of the food chain and to increase productivity and have resulted in three major consequences: 1) increasing excess supply and decreasing real food prices; 2) a deep industrialization of agrarian societies helping them to accumulate capital, free up labor and provide more nutritious and value added food; and 3) a substantial transformation of citizens' lifestyles as a consequence of rising income, urbanization and changes in food sector (globalization of the food industry and retailing sectors, fast-food, e-commerce,…).

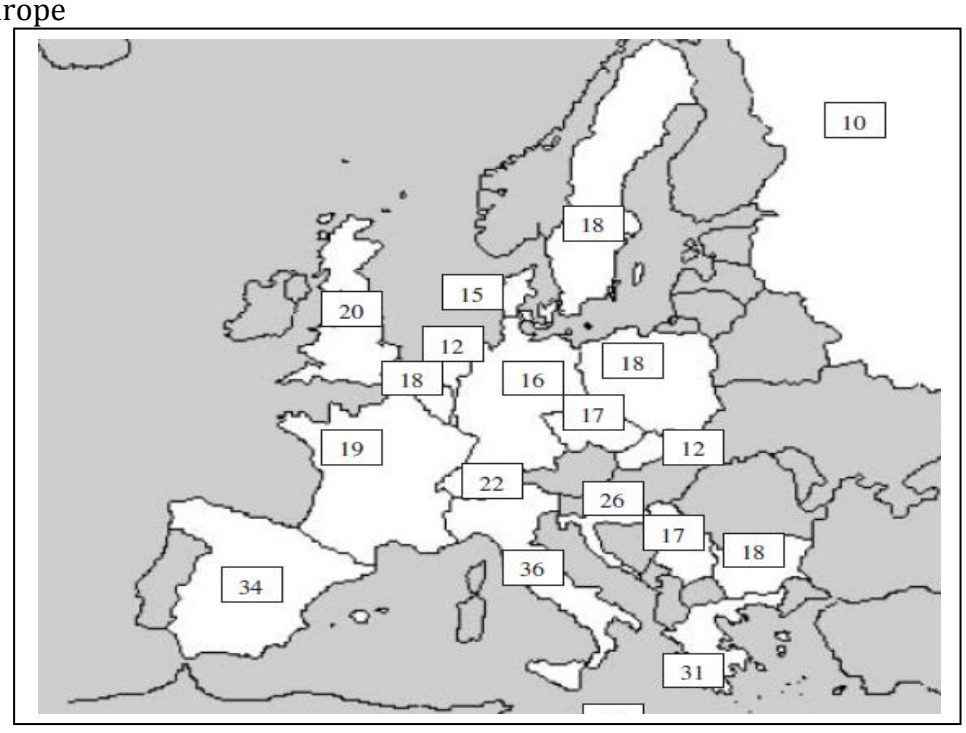
These changes have generated two important consequences on food demand. On one hand, as Gil et al. (1995) show, declining real food prices has generated not only an increase of total calorie intake but also a shift towards a higher calorie density diet that is richer in cholesterol and saturated fats (i.e. higher consumption of meat, eggs, dairy products and sugar). On the other hand, the increasing sedentary lifestyle has made calories expenditures to decline. As a result of both trends, food diets in most developed countries are clearly imbalanced having generated a rapid increase of the prevalence of overweight, obesity and related non-communicable diseases.

The World Health Organization (WHO) estimates that worldwide there are 1.6 billion overweight adults and, at least, 30% of them are obese (WHO, 2007). By 2015 these figures are expected to rise at 2.3 billion overweight and 700 million obese adults. Furthermore, while obesity was once considered a problem just for the high-income countries, overweight and obesity are now dramatically on the rise in low and middle-income countries without Spain being an exception. Obesity is associated with a number of chronic diseases, including cardiovascular diseases and diabetes, currently representing 7% of Spanish Health care costs. The increasing obesity problem has now

become a public health problem that deserves attention from public authorities in order to implement policy measures to have an impact on food consumption, the quality of diet, physical activity and, consequently, body weight. To address such concerns, in Spain, the Strategy for Nutrition, Physical Activity and Prevention of Obesity (NAOS) was launched in 2005 bringing obesity and overweight to the forefront of social concerns. In 2011, the Spanish Government launched the new Law of Food Safety and Nutrition under which, in 2013, the Observatory for Nutrition and Obesity Studies was created.

Special attention has been paid to childhood obesity as some food and lifestyle habits tend to persist during their life (cohort effect). Worldwide, WHO (2014) estimates that 170 million children (aged < 18 years) are obese. Although in Spain figures for adults are not very different to that for other countries, the key concern seems to be the potential rise in obesity which can be forecasted by evaluating the rates of overweight children. The prevalence of obesity among children in Spain in 2012 was 9% while the overweight rate reached 26%. During the last 6 years, the situation has worsened as the prevalence of overweight was only 21% (the prevalence of obesity has not changed). Although making international comparisons is not easy, Figure 1 shows that Spain is one of the countries in which the prevalence of childhood (children between 7 and 11 years old) obesity and overweight is higher.[1]

Figure 1. Prevalence of obesity and overweight among children aged between 7 to 11 years in Europe



Source: Lobstein and Frelut (2003)

Childhood obesity and overweight can generate significant reductions in quality of life (Tsiros et a., 2009) and a greater risk of teasing, bullying and social isolation (Lobstein et al., 2004). Thus, a better understanding of factors affecting childhood

[1]It is difficult to find a study in which figures can be compared. In the literature there are a large number of studies in different EU and non EU countries but comparisons are not an easy task as they differ in the year of the measurement or the age of the children. In some cases, there exit some results from EU projects in which results are comparable but they have more than one decade.

obesity is needed in order to provide more accurate information to policy makers on how to orientate their policies. This is precisely the main objective of this paper. Our assumption that although it is true that genetic factors may explain the magnitude of metabolic complications associated to obesity (Cardon et al, 1994), environmental factors such as dietary behavior and lifestyles are largely blamed as the major driving forces behind the epidemic outburst of obesity since the 1970's (Chou et al., 2004; Rashad et al., 2005; and Binkley, 2006).

The increasing childhood obesity rate has generated a significant number of studies covering two important issues: the use of more accurate anthropometric measures and the analysis of main determinants of the prevalence of obesity (Ochoa et al., 2007; Moreno and Rodríguez, 2007); Vicente-Rodriguez et al., 2008; Estudio ALADINO, 2013; among many others). Most of these studies are the result of national and international projects with acronyms such as: AVENA, HELENA, PORGROW or ALADINO, led by well reputed medical and nutrition research groups. In general, results come from longitudinal studies conducted on a representative sample at regional or national levels. Some studies are interested in a single factor and its relationship with the prevalence of childhood obesity (the two more mentioned factors are sedentariness and dietary habits). While data sets are very exhaustive, the methodological framework these studies used are relatively simple and are based on simple correlations. In some cases, some regressions are estimated but the number of explanatory variables is very limited. Finally, the role of economic factors is almost neglected. From an economic point of view, we are only aware about the study of Garcia et al. (2006), who used secondary information from the 2003 Spanish Health Survey, focusing on the relationship between maternal employment and childhood obesity in Spain.

This study is going to use microdata from the same survey than in the latter case (in this case from 2012). Although we recognize that this dataset can be more limited than longitudinal studies, our main contribution is focused on the methodological framework we have adopted. A multivariate approach has been adopted here to analyze main factors affecting the prevalence of obesity in Spain which is based on the specification and estimation of a Sample Selection Model. As we will discuss later, we have assumed that the Body Mass Index (the variable used in the National health Survey to measure the prevalence of obesity) is censored: it takes the value zero if the child has a BMI corresponding to normal weight, and the corresponding BMI value, otherwise.

2. Literature review

In case of children, parents are definitely implicated in their daily life and influence their diet and lifestyles which, ultimately, influence their weight status together with their social environment at school and at the neighborhood. Moreover, there exist intrinsic characteristics of children (genetics, metabolism…) which have an obvious influence. As a consequence, analyzing factors affecting the prevalence of children obesity is not an easy task. There are many factors affecting and most of them are interrelated; thus, it is difficult to isolate the effect of each individual factor. This can explain also why some studies have found different results on the impact of specific factors on childhood obesity. By including or excluding specific factors results can be different. But each specific study is also contributing to increase the knowledge on this challenging issue.

Taking into account the nature of this study, the literature review is going to focus on environmental factors affecting childhood obesity, although recognizing that intrinsic

children characteristics are also very important. Among the most relevant environmental factors the literature suggest: the children dietary patterns (consumption and frequency of consumption of some food), the children lifestyle (physical activity, the sedentary character, like the time spent watching TV, playing video-games, and the sleep duration), the parental socio-economic situation and economic factors (like the influence of food prices in the market).

Socio-demographic factors

The age and the sex of the child are variables commonly considered in childhood obesity studies because of the existing differences in the physiology of puberty, like hormonal changes. In general terms, boys are more likely to be overweight or obese. Hume et al. (2008) found that among adolescents in Australia aged 13–14 years the prevalence of overweight at the beginning of the study were 13% among boys and 16% among girls, increasing in both cases up to 21% at the end of the study. Similar results were found in Au and Yu (2012), in a development trajectory study of adiposity in relation to socio-demographic status of children in a local primary school in Hong Kong between 2001 and 2005, Nasreddine et al. (2009), among adolescents in Lebanon, and Oliver et al. (2012) in New Zealand, among others.

In boys but not in girls (7-9 years old), the decline in moderate to vigorous physical activity (MVPA) was associated to a greater increase in fat mass index (Basterfield et al., 2012). While among girls the physical activity is a function of both intrinsic variables, like the desire to be active, and extrinsic variables like the age, the health status, the time watching TV and the high parental physical activity, among boys it depends just on their desire to be active (Yamamoto et al., 2009)

In the case of Spain, similar results have been found. In the AVENA study, results showed that among adolescents between 13 and 18 years old, the risk of obesity decreased by 17.8% per year among boys and 27% among girls (Vicente-Rodríguez et al., 2008). Monitoring Spanish children between 6 and 7 years old, showed a significant increase of the prevalence of overweight among boys. In fact, at the beginning of the study the prevalence was 21% among boys and 25% among girls, while at the end, percentages grew up to 34% among boys and 36% among girls (Moreno et al., 2005).

Children lifestyles

A common result found in the literature is that the childhood weight status is associated with their sedentary or active lifestyle: the time they spend watching TV, playing video games or with their mobile phones, their sleep duration and the practice of some physical activities, among the most relevant.

After analyzing 28 longitudinal studies among children and adolescents, Rey-Lopez et al. (2008) concluded that most of them (19 studies) revealed a positive association between TV watching and the child adiposity and just one study revealed such an association with playing video games or using computers. Moreover, Basterfield et al. (2012) showed that the significant increase in fat mass index among English boys between 7 and 9 years old had been associated with the decline in moderate to vigorous physical activity**.**

Physical activity itself has been associated with the time spent watching TV. In fact, Devís-Devís et al. (2012) and Proctor et al. (2003) found a negative association between the time spent playing video games or with mobile phones and the adolescent physical activity for both male and females. However, results from the project STIL (Sedentary

Teenagers and Inactive Lifestyles) in UK (Biddle et al., 2004) showed that there was not a significant correlation between time watching TV or playing video-games and the children physical activity, suggesting that there is time for both things and that the level of physical activity might depend on other factors which could have more influence on children lifestyles.

In Spain, each hour watching TV during weekends increases the risk of being overweight by 15.8% among adolescents and each hour spent playing videogames increases this risk by 9.4% (Vicente-Rodriguez et al., 2008).

Sleep duration is another factor that influences significantly the prevalence of overweight, being more important among males than among females (Knutson, 2005 and Ochiai et al., 2012).

Parental and socio-economic status

As mentioned above, children lifestyles and their dietary habits are significantly influenced by the household socio-economic status as well as the parents' education level or the time they spend caring them (Papoutsi et al., 2013). The parents' economic situation seems to be a key factor to explain the children weight status. In general terms, results from different studies suggest that there exist a negative correlation between household income and children obesity (as the household income decreases, the probability of being overweight/obese increases) (Sanjay et al., 2000; Merten et al., 2009; Eagle et al., 2012). Navalpotro et al. (2012) extended this result to regions with lower per capita income and Moreno et al. (2004) and Maddah et al. (2009) to household living in rural areas. The easier access to fast foods, the poorer access to fresh fruits and vegetables as well as the poorer access to recreational parks and school-based exercise programs, are key factors explaining the prevalence of overweight and obesity in those communities (Eagle et al., 2012). Additionally, some studies have revealed that in low income families, the most related factor to children's overweight are the parental education level (Nasreddine et al., 2009) and the mothers' role (Moreno et al., 2004 and Cho et al., 2009).

The mother participation in the labor market (or the more time parents spent working outside, implying a third person (non-parental) spending more time with children),has been showed to be statistically significant in predicting the likelihood of childhood obesity or overweight (Loureiro and Nayga, 2005; Cawley and Liu, 2007 and Wendt, 2008). In these cases, the likelihood of eating less healthy, or eating in non-regular times or not respecting the TV watching hours increases (Anderson, 2012). Related to this issue, parents' childcare has been also associated to children overweight although, in fact, fathers and mothers provide different childcare which generates different impacts on their children's' nutrient intake and outcomes (McIntosh, 2006). As, usually, mothers' implication on children dietary patterns is higher than that of the father and the time she spends with her child at home influences more her children weight status (Anderson, 2012). Finally, some authors have found a significant and positive correlation between the parental weight status and children obesity (Agras et al., 2004).

In the case of Spain, in the above mentioned AVENA study a significant relationship has been found between children obesity and the socio economic status of households. The most relevant variables included in this study were: 1) parents' occupation; 2) their employment status and education level; 3) household size and number of children; 4) who is the responsible of food shopping and cooking; and 5) the parental obesity status.

Results indicate that among females, the maternal education level and the maternal obesity were the most important determinants of their overweight status. Among males, all variables related with the mother were important. Finally, García et al. (2006) showed that for the case of Spain the implication of the mother in the labor market influenced negatively the children weight status (if the mother worked the children likelihood of being overweight increased). In the same context, Gutiérrez-Doménech (2010) found that employed mothers provide almost three times as much time in "basic primary childcare" like feeding than employed fathers.

Economic factors

The household economic situation itself is influenced by other market parameters which have been determined as conductors of the childhood overweigh/obesity. This is why there is an increasing literature addressed to investigate how markets may contribute to the promotion of imbalance energy consumption and the sedentary lifestyle (Papoutsi et al., 2013). According to Cawley (2006), there are three main economic factors that have contributed to the recent increase in childhood overweight: 1) the increase competition has generated a decrease of real food prices (energy-dense foods have become relatively cheaper than less energy-dense foods, such as fresh fruits and vegetables); 2) rising wages have encouraged new practices addressed to spend less time preparing meals; and 3) technological changes have encouraged the increasing consumption of prepackaged food rather than to prepare meals at home. We could also include in this section the increasing participation of women in the labor market mentioned above.

Dietary habit and food consumption

Children eating patterns, their food preferences, the quantity and frequency of consumption of some food items and having breakfast or skipping it are all important elements which highly can influence their weight status. During week days, children generally eat at school and the meal can be prepared at home or at the school canteen. In general terms, children who have lunch at school eat significantly more healthy food like dairy products, fruit and vegetables (Wolfe and Campbell, 1993). However, it is common that children from low-income families skip the meal at school when the food served is not the one they prefer, so they switch to snacks or increase night eating which increases the probability of being overweight (Damman, 2010). When eating at home, however, the choice of food depends generally on the food availability and some reported restricted eating styles.

Nutritionists have agreed that not only having breakfast but the type of breakfast children eat has a strong impact on children overweight. The regular consumption of breakfast provides considerable protection from obesity during adolescence (Merten et al., 2009 and Vanhala et al., 2009). On the other side, Wolfe and Campbell (1993) showed that children living with a single parent were more likely to skip their breakfast as well as children from disadvantaged and rural areas (Maddah et al., 2009), increasing the likelihood of being obese. In relation to eating habits, the childhood obesity has been often associated with fatten food intake (Oliveria et al., 1992) as well as with food preferences (Borah-Giddens and Falciglia, 1993).

In Spain, Ochoa et al. (2007) aimed at identifying obesity risk factors associated to children lifestyle and dietary habits. The study focused on 185 obese children and adolescents from 6 to 18 years old from Navarra and revealed that the consumption of fish, legumes, potatoes, cereals and dairy products were not associated with obesity, but

it was significantly associated with sugar-sweetened beverage consumption. Moreno and Rodríguez (2007) did not find a clear relationship between energy intake and childhood body fatness. They concluded that maybe instead of focusing in simple food composition and energy intake, the research should better focus on eating patterns like: number of meals per day; type of breakfast; type of dinner; family supervision when eating; the number of servings of sugar-sweetened drinks; or the frequency of eating in 'fast food' restaurants.

3. Data: The National Health Survey

Data in this study has been taken from The Spanish National Health Survey (ENS) 2011-2012. The ENS is conducted by the National Institute of Statistics (INE) and was born as a biennial investigation aimed at providing the necessary information about the population health in order to help policy makers to adopt appropriate health policies. The main areas information is collected refer to health status, environment, lifestyle and preventive practices, and the use of health services, among the most relevant. The first of these surveys was made in 1987 and previous surveys were carried out in 1993, 1995, 1997, 2001, 2003 and 2006.

The INE, 2013 collects information from 21,508 Spanish households with 21,007 adults (15 years old and over) and 5,495 children /under 15 years old). Interviews were conducted between July 2011 and June 2012. As in previous years: the survey is divided into three questionnaires: 1) Household questionnaire; 2) Adult questionnaire; and 3) Children questionnaire

The household questionnaire collects information about all members within the household including some basic demographic variables as well as the socio-demographic characteristics of the person who contributes most to the household budget (reference person). The adult questionnaire collects information on one selected member of the household over 15 years. If they have children at home, a questionnaire of minors is filled in. The design of the questionnaire for the 2011-12 was slighted reformulated over previous editions to harmonize the Spanish and the European surveys to guarantee some comparability. The most important change is the reduction of the age limit for the survey of adults from 16 to 15 years. Another important novelty in this edition is the introduction of computer-assisted personal interview (CAPI) as the method to gathering information.

The type of sample used is a three-stage stratified sampling. The first stage units are the census sections. The second stage units are the main family dwellings (household). Within each selected household one adult (over 15 years) is selected to complete the Adult Questionnaire and, in case there were have minors (0-14 years), one is also selected to complete the Children Questionnaire which will be the focus in this study, although some household characteristics will be taken from the other two questionnaires.

A total of 5495 children aged between 0 and 14 years were interviewed. For the purposes of this study, children under 2 years old were not considered as the BMI measure was not available. Furthermore, we are going to focus our study on children within schooling age (from 5 to 14), as we have found also a lot of missing values in children at the kindergarten. In doing that, we are covering all children at the primary school (from 5 to 11) and more or less half of the children at the secondary school (from 12 to 14) (note that secondary school in Spain covers up to 16 years old). The final

sample, one discarding children without BMI information, consisted of 1055 children. Table 1 shows their main socio-demographic characteristics.

As can be observed; the percentage of females (45.6) is slightly lower than that for males (54.4). Approximately two thirds of the children were at the primary school (5 to 11 years). Table 1 also shows some data about the adult fulfilling the questionnaire within the household. Sex was equally distributed among respondents (49% male and 51% female). In relation to their education level, more than 56% of the adults have finished the secondary school or have attained a professional qualification. Around 21% has an elementary education level and 23% has got a university degree. Finally almost three out of four adults are married or live with a partner.

Table 1. Socio-demographic characteristics of children in the sample (n=1055)

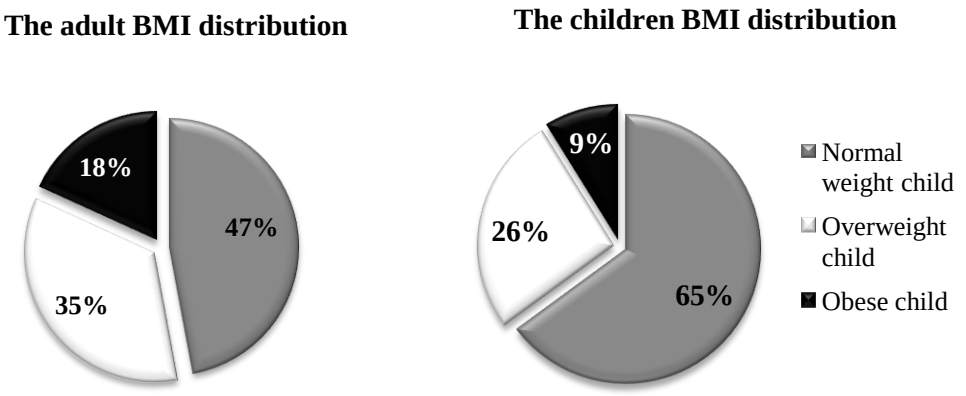
	%
Child gender	
Male	54.4
Female	45.6
Adult gender	
Male	48.9
Female	51.1
Child age ranges	
5-11 years old (primary school)	62.6
12-14 years old (secondary school)	37.4
Parental marital status	
Single	13
Married	73
Widowed	3.5
Legally separated	1.7
Divorced	3.7
Nationality	
Spanish	97.1
Foreign	2.9
Adult attainment level	
-No education or elementary level	20.9
-Secondary studies	56.4
-Advanced studies (academic studies or higher professional education)	22.7

Source: Own elaboration from ENS 2011-12 (INE, 2013)

In the ENS, the children weight status is assessed according to the definition established by the International Obesity Task Force taking into account both the weight and the height to calculate the Body Mass Index (BMI). Among the population between 2 and 17 years old, the BMI figure has been corrected by age and gender in order to properly classify children as overweight or obese (*Cole et al*., 2000). Figure 2 shows the prevalence of obesity and overweight in both adults and children in Spain. As can be observed, for the adult population, the prevalence of obesity is 18% while 35% are overweight. In relation to our children sample, the prevalence of obesity was 9% while overweight accounts for 26% of the sample. Comparing results with the last survey available (2006), there has been an increase in the prevalence of overweight among

Spanish children. In fact, in 2006 the percentage of children with normal weight was 70% (65% in 2011-12) while the percentage of overweight children was 21%. The prevalence of obesity has not change (9%) (Table 2)

Figure 2. Prevalence of overweight and obesity among adults and children in Spain



Source: Own elaboration from ENS 2011-12 (INE, 2013)

Table 2. Comparison of the prevalence of childhood obesity and overweight among Spanish children between 2006 and 2012

	2006	2012
Normal weight children (%)	69,9	64,9
Overweight children (%)	21,2	26,3
Obese children (%)	9,0	8,8

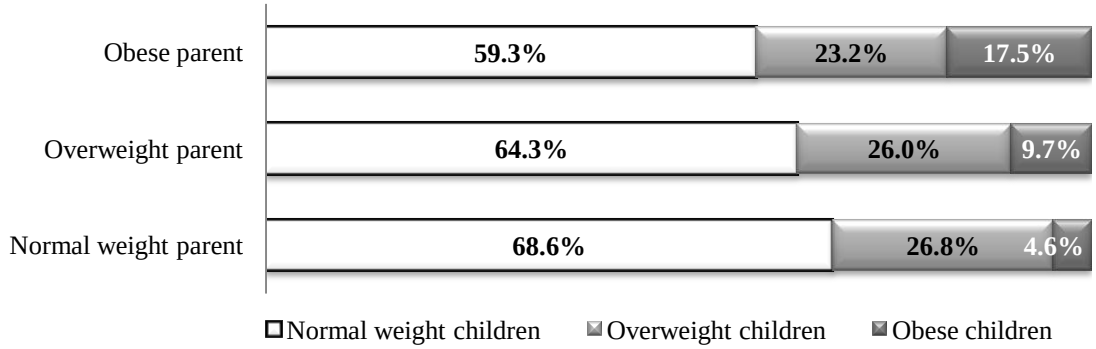
Source: Own elaboration from ENS 2011-12 (INE, 2013)

The relationship between adulthood obesity and childhood obesity is represented in Figure 3. In households where at least one parent is obese, the prevalence of obesity and overweight among children is higher (40%), while in households where at least one parent is overweight this percentage diminishes to 36%. If parents have normal weight the percentage of obesity and overweight decreases to 32%.

4. Econometric Framework

The econometric framework to analyze main factors affecting the prevalence of childhood obesity and overweight in Spain is mainly determined on how the dependent variable is measured. If BMI is measured as a categorical variable (normal weight, overweight and obesity, as an example), a Multinomial Logit Model is appropriate. However, this model only provides information on how the selected factors contribute to change from one category to another, but does not provide information about changes in BMI values within each category. If BMI is measured as a continuous variable a simple regression (under any functional form) can be specified. However, in this case, parameters estimates measure marginal changes in BMI values along the whole sample, independently if the children have a normal weight, are overweight or obese (parameters are constant along the full sample).

Figure 3. Relationship between adult and children obesity in Spain



Source: Own elaboration from ENS 2011-12 (INE, 2013)

In this study, BMI has been measured as a censored variable: if children have a normal weight, their BMI is set to zero; otherwise, BMI is measured as a continuous variable. In this framework, the main contribution of this study is to estimate a Sample Selection Model (SSM) to analyze main factors affecting childhood BMI. The SSM consists of two equations: 1) the participation equation, a probit model, in which factors affecting the probability of children to be overweight or obese over normal weight children are considered; and 2) the outcome equation (only for overweight and obese children), which allows us to analyze factors affecting children BMI in this specific segment. The set of explanatory variables can be different in the two equations. The two equations can be expressed as follows:

1. The selection equation, where the dependent variable ($d_{1,i}$) is a dichotomous variable that equals 1 if the child is overweight or obese (; and 0, otherwise.

2. The outcome equation, where the dependent ($y_{2,i}$) variable is the BMI for overweight or obese children (

where represents the children BMI, which is observable if and only if . Taking this into account, the Sample Selection Model is given by:

where = , (j=1, 2) are vectors of independent variables in each of the two equations. ,(j=1, 2) are vectors of the estimates (parameters). The are the errors terms, following a normal distribution , j=1, 2 with

The sample selection model is estimated by Maximum Likelihood. According to Amemiya (1984), the Likelihood expression for the sample selection model is defined as:

from which the Likelihood Function is given by:

(1)

where are the parameters to estimate; is the dichotomous variable of ; and is the observed variable of ; and is the conditional density function of when

Given that and are normally distributed (and , respectively), the conditional of knowing that is also normally distributed. Thus, the expression of the likelihood function of the Sample Selection Model is given by:

(2)

In (2) we can just identify the following parameters: , , , and —. For this reason, we will impose in order to identify all parameters. Finally, in order to guarantee the convergence of the estimation process, we are going to use the Olsen parameterization mentioned above, which is given, in this case, by: —, —, — and —

Taking all of this into account the expression of the log of the likelihood function that should be maximized is given by:

5. Main determinants of childhood obesity in Spain

To analyze main factors affecting childhood obesity in Spain we have taken into account the literature review in section 2 and the specific characteristics and

information contained in the database (ENS). Explanatory variables have been grouped in the following categories: 1) Socio-demographic factors (age and gender); 2) Socio-economic status of parents ("Social class" [2], Parents' education level, Town size, Marital status, Parents BMI and Household size); 3) Childhood lifestyles (Number of hours sleeping every day, Time spent watching TV on week days and on weekends, Time spent playing videogames or with the computer on week days and on weekends; Physical Activity; Availability of green spaces in the area; 4) Dietary habits (food consumption and type of breakfast the children have); and 5) Diet Quality Index.

The last two categories need further consideration as the information provided by the ENS is very limited. Parents are asked to fill a self-reported questionnaire related to the frequency of consumption of 12 food groups (fresh fruits, fresh vegetables, fresh meat, processed meat, fish, eggs, pasta and rice, legumes, snacks, soft drinks, sweets and fast food). Five frequency levels are defined: i) daily; ii) 3 or more times per week but not daily; iii) one or two times per week; iv) less than one time per week; and v) no consumption. For each child, we have compared the frequency consumption of each type of food category with the recommendations set in the Spanish Healthy Eating Guide (Guía de la Alimentación Saludable en España) elaborated since 1989 by the Spanish Society of Community Nutrition (SENC). If the frequency of consumption matches the recommendation, the child's consumption of such food category is labeled as adequate and inadequate, otherwise.[3]

In relation to the construction of the Health Eating Index, the following procedure has been followed using again data from the ENS and the recommendations by SENC. In this case, the frequency of consumption of the different food categories has been classified in three categories: if the frequency of consumption matches the SENC recommendation, we assign to this child 10 points; if the frequency differs in one category, we assign 5 points (for instance if the recommendation is 3-4 times per week and the individual consumes this specific product daily or one or two times per week); finally, if the recommended level differs in more than one category, we assign 0 points to this specific individual for such product category. As we have 12 food categories, the maximum value for this new variable ranges between 0 and 120[4]. Table 3 shows the full set of explanatory variables that have been considered in this study.

Table 4 shows the estimated parameters for the two equations. One of the most important coefficients is ρ, which represents the correlation between the errors in the two equations. As can be observed the value is 0.345, which is different from zero, suggesting that the Sample Selection Model is adequate for the purposes of this study. The R^2 in the SSM is high as the model explains 42% of the variability of the response data around its mean.

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[2] The ENS segments the population in six social classes: I: Directors and managers of establishments with 10 or more employees and professionals traditionally associated with university degrees; II: Directors and managers of establishments with fewer than 10 employees, professionals traditionally associated with university degrees and other professional technical support. Athletes and artists; III: Intermediate occupations and self-employed; IV: Supervisors and skilled workers in technical occupations; V: Skilled workers in the primary sector and other semi-skilled workers; and VI: Unskilled workers.

[3] This classification has to be interpreted with caution as we are considering only the frequency but to the quantity consumed

[4] The defined Healthy Eating Index was negatively correlated with the children BMI (-0.06, significant at the 10%)

Table 3. Potential explanatory variables explaining childhood obesity in Spain

Name	Description
Age	The age of the child
Sex	The child gender. Male=1 Female=2
TS_1	Town size over than 500.000 inhabitants=1, otherwise =0
TS_2	Town Size between 20.000 and 500.000 inhabitants=1, otherwise =0
TS_3 (reference)	Town size less than 20.000 inhabitants=1 otherwise=0
Class_1 (reference)	Upper social class = 1; otherwise =0
Class_2	Medium social class = 1 otherwise =0
Class_3	Low social class = 1, otherwise=0
MS	Marital status: Married or living with a couple =1, if single or divorced=2
GS	Availability of green space in the neighborhood=1, if not =2
HS	Number of persons living within the household
E_1	Parents with primary school = 1; otherwise = 0
E_2	Parents with secondary school = 1; otherwise = 0
E_3 (reference)	Parents with university degree = 1, otherwise = 0
BMIa_1 (reference)	Normal weight parent=1 otherwise = 0
BMIa_2	Overweight parent=1 otherwise =0
BMIa_3	Obese parents=1 otherwise =0
Sleep	Number of hours children use to sleep every day.
TVwdays	The time the child spends watching TV during weekdays (more than 1h/day=1, less than 1 h/day=0)
TVwkends	The time the child spends watching TV during weekends /weekdays (more than 1h/day=1, less than 1 h/day=0)
VGwdays	The time the child spends playing video games during weekdays (more than 1h/day=1, less than 1 h/day=0)
VGwkends	The time the child spends video gamesduring weekends weekdays (more than 1h/day=1, less than 1 h/day=0)
PA_low	Low level of physical activity=1 otherwise =0
PA_medium	Occasional physical activity =1 otherwise =0
PA_high (reference)	Regular physical activity =1, otherwise =0
Breakfast	Having breakfast every morning=1, if not = 2
DQI	Diet Quality Index (see section 4.1)
C_ffruit	Adequate consumption of fresh fruits=1, otherwise=0 (section 4.1)
C_meat	Adequate consumption of meat=1, otherwise=0 (section 4.1)
C_eggs	Adequate consumption of eggs=1, otherwise=0 (section 4.1)
C_fish	Adequate y consumption of fish=1, otherwise=0 (section 4.1)
C_pasta	Adequate consumption of paste=1, otherwise=0 (section 4.1)
C_vegtab	Adequate consumption of vegetables=1, otherwise=0 (section 4.1)
C_legum	Adequate consumption of legumes=1, otherwise=0 (section 4.1)
C_sausag	Adequate consumption sausages=1, otherwise=0 (section 4.1)
C_sweet	Adequate consumption of sweets=1, otherwise=0 (section 4.1)
C_Softdrk	Adequate consumption of soft drinks=1, otherwise=0 (section 4.1)
C_Fastfood	Adequate consumption of fast food=1, otherwise=0 (section 4.1)
C_Snacks	Adequate consumption of snacks=1, otherwise=0 (section 4.1)

The first equation, the selection equation is a Probit equation and should be interpreted accordingly. Results from Table 4 indicate that, among the socio-demographic factors, age and sex are the most relevant. In fact, being older and male increase the probability of being obese. In relation to the socioeconomic status of the households, we have found that the probability of children to be overweight or obese increases in larger towns and rural areas in relation to middle size towns. Additionally, the probability of the prevalence of obesity is higher in the wealthier social class. Finally,

our model indicates that in households where parents are obese, the probability of existing overweight or obese children also increases.

Table 4. Parameter estimates from the Sample Selection Model

Variables	Sample Selection Model		Tobit Model
	Selection Equation	Outcome equation	
Intercept	14,26	0.20	10.72
Age	0,61***	0,07***	ns
Sexo	0,91*	0,58***	- 3,68***
TS_1 (town size)	ns	0,25*	ns
TS_2 (town size)	-0,85*	0,30**	-2,24***
Class_2	-2,05***	ns	-1,52*
Class_3	-1,38**	ns	ns
MS (civil state)	-1,98***	-0,41***	1.46**
GS (green space)	-1,64***	ns	ns
HS (num person at home)	ns	ns	-0,89**
E_1(study level)	ns	ns	ns
E_2	ns	ns	ns
BMIa_2	ns	ns	ns
BMIa_3	2,65***	-0,36**	3.19***
Sleep	ns	ns	ns
TVwdays	ns	ns	ns
TVwkends	ns	ns	ns
VGwdays	2,25***	0,53***	-2.54**
VGwkends	-1,88***	0,22*	-1.92**
PA_low	1,76*	ns	2.42**
PA_medium	2,40***	ns	2.52**
Breakfast	ns	ns	ns
DQI	ns	-0,02**	0.15**
C_ffruit	ns	0,44***	-2,47**
C_meat	1,66**	ns	1.66*
C_eggs	-1,34**	ns	-1,87*
C_fish	1,19*	0,28**	ns
C_pasta	ns	0,41**	-1,76*
C_vegtab	ns		ns
C_legum	ns	0,53***	-3,49***
C_sausag	ns		ns
C_sweet	ns	0,30**	-1,62*
C_Softdrk	ns	0,46***	-3,35***
C_Fastfood	ns	ns	ns
C_Snacks	ns	ns	ns
ρ	0.345**		
R^2	42.2%	42.2%	
White heteroskedasticity test	-	-	19.29

See Table 3 for a definition of variables.

***: Indicates significant at 99% level. **: Indicates significant at 95% level. *: Indicates significant at 90% level; ns = not significant

Results also indicate that there is a significant relationship between physical activity (PA) and the probability of being overweight or obese. In fact, lower PA is positively related to the probability of being obese. Sleeping hours and the period of time spent watching TV are not significant in the children's' probability of being obese.

Finally, the time spent playing videogames has two different effects depending on the period children play. During weekdays there is a negative relationship between the time playing videogames and the probability of being overweight (less time spend playing videogames, higher is the child BMI). However, the effect is just the opposite if children play videogames during weekends.

We have not found any significant relationship neither between the Diet Quality Index nor the type of breakfast and the probability of children to be overweight or obese. In relation to specific food products, results indicate a significant effect of an inadequate consumption of meat, eggs and fish and the probability of children to be obese or overweight.

In relation to the second equation, results indicate that socio-demographic variables are relevant in the two equations. In overweight and obese children, BMI increases with the age and in boys, which is also consistent with the existing literature referred to other countries reviewed in section 2. In fact, BMI increases by 0.07 per year and, on average, BMI for boys is 0.58 points higher than for girls.

One interesting result in that, although the probability of being overweight or obese diminishes in middle size towns, once we consider only overweight and obese children, BMI values are higher than in rural areas. The same trend has been found in larger towns among overweight and obese children. In relation to the social class, we mentioned that the probability of being obese in higher income households is higher than in other social classes; however, the average BMI among overweight and obese children is the same in all social classes. Considering the parental marital status, our results indicate that living with both parents decreases the children average BMI by 0.41, consistent with previous literature review.

Past literature suggests that children lifestyles and food habits are key determinants of childhood obesity. Results in this study suggest that this is true when we are analyzing the probability of being overweight/obese (selection equation) but it is not relevant in the outcome equation. Households where parents are obese are more likely to have overweight and obese children (selection equation), but once we consider only overweight and obese the average children BMI is lower in such type of households. The second relevant lifestyle variable is the time spent playing videogames. During weekdays, children who spend less time playing videogames (less than 1 hour/day) are more likely to be overweight or obese. However, for overweight and obese children, the relationship between time playing videogames and BMI is positive and significant.

Finally, let us discuss results related to food consumption habits. Three important results should be outlined. First, having or not breakfast has not an impact on overweight and obese children BMI. Second, the Diet Quality Index is significant and negative, that is, among overweight and obese children a better quality diminishes their BMI levels. Third, estimated parameters indicate that an inadequate intake of some food categories tend to increase the children BMI. Fo instance, the BMI of obese and overweigh children increases by 0.44 for an inadequate intake of fresh fruits, 0.28 for fish, 0.41 for pasta and rice, 0.53 for legumes, 0.30 for sweets and 0.46 for soft drinks.

6. Discussion

Results from this study suggest a number of points. First, and consistent with previous literature, among children's socio-demographic characteristics, being older and male increase the probability of being obese as in Vicente-Rodríguez et al. (2008).

Additionally, the prevalence of obesity increases as the children live in a household belonging to the higher social class as well as in households in which parents are obese. Lower childhood physical activity is positively related to the probability of being obese as in Basterfield et al. (2012). Finally, the time spent playing videogames during weekends has a significant and positive association with the prevalence of obesity. The more time playing videogames the higher the children BMI is (Vicente-Rodríguez et al., 2008).

In relation to eating habits, the childhood obesity has been often associated, in many papers with fatten food intake (Oliveira et al., 1992) as well as with food preferences (Borah-Giddens and Falciglia, 1993). However, in Spain, Moreno and Rodríguez (2007) concluded that there was not enough evidence to clarify the importance of childhood diet on their weight status. In our study, and again with all limitations derived from how the variable has been measured, we have found that eating habits has a significant role in explaining childhood overweight and obesity. In fact, the diet Quality index is significantly negative (the lower the Diet Quality Index, the higher the BMI is). Moreover, we have found a positive relationship between the inadequateness intake of some food products and the children BMI.

In any case, although we have tried to fill a gap in the existing literature, further research can be done in the future. First, the research which is currently undertaken in medical research centers could incorporate the methodological approach we have proposed here to get more insight on the data they have. Most of the research in these centers are of seminal importance as they are working with more sophisticated tools to measure childhood obesity and they collect very detailed information on children including genetics, metabolism, lifestyles or households characteristics.

Second, to tackle the obesity issue we need more economic information. In this context the information on prices is very important. In the last five years, the price has become one of the most important attributes consumers are taking into account when purchasing food products. Moreover, some of the policies that have been suggested to reduce the prevalence of obesity include changing taxes for “healthy” and “unhealthy” food. To better know the potential impact of this policy, more information is needed about how people react to price changes.

Finally, our results indicate that children and household lifestyles also play a pivotal role on the prevalence of obesity. Changing lifestyles is not an easy task. We need more research from social scientists (sociologists, psychologists...) in order to better understand consumers’ behavior and what type of stimuli would be more effective to change children lifestyles.

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