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S*ocial interactions* and the contemporaneous determinants of individuals' weight[*]

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Abstract

Obesity and overweight are central issues in the public health debate in most developed countries. In this debate, some of the socio-economic determinants of obesity and overweight are still relatively unexplored. This paper presents an empirical examination of the possible influence of social interactions on contemporaneous obesity and (over)underweight. We apply a joint estimation model for obesity and self-image to a sample for Spain taken from the European Union household panel for 1998. Our results suggest that obesity might be in part a social phenomenon connected to individuals' social life.

Keywords: Obesity, self-image and employment.

1. Introduction

Obesity is one of the major health problems in developed and developing societies (Wang et al, 2002). Its prevalence has risen three-fold since 1980 in areas of North America, the UK, Eastern Europe, the Pacific Islands, Australasia and China[1]. The WHO (2003b) estimates that obesity rates have increased by 10-40% in most European countries over the past 10 years and that the condition is relatively common among women and in southern and eastern European countries (Table 1). Childhood obesity is also escalating alarmingly, especially in southern Europe, where rates are 10-20% higher than in the north.[2]

Obesity is an important issue because it is responsible for numerous health complications, ranging from non-fatal debilitating conditions such as osteoarthritis, respiratory difficulties, skin problems and infertility, to life-threatening chronic diseases such as Coronary Heart Disease, type II diabetes, and certain cancers.[3] Obesity may also have psychological consequences, including lowered self-esteem and clinical depression. Further, from the economic perspective, it is estimated that treatment for obesity accounts for between 2 and 8% of the overall health budgets in western countries. In addition to the direct economic impact, the indirect costs of obesity may be far greater if we include workdays lost, visits to doctors, disability pensions, loss of wages and productivity, and premature mortality. Proposals to deal with the problem range from the provision of education to formal incentives or punishments such as the recent plan (2003) drawn up by the British NHS to oblige the obese population to sign a contract by which they commit themselves to a healthy lifestyle in order to receive health care.

Like other developed countries, Spain is experiencing a rise in obesity, in both adults and children. Between 29-35% of six- and seven-year-olds suffer from overweight and between 8-16% from obesity. Among the Spanish population aged 2-24, overweight is running at 21.4% and obesity at 5.8%. Overweight children often become overweight adults; indeed, obesity has become a major health policy issue, responsible for some 28,000 deaths a year (8.5% of the total). Causes of obesity include genetic inheritance and poor diet, and, increasingly, sedentary behaviour. According to the latest available data from the Spanish Ministry of Health (2003), 50% of the Spanish population have a sedentary lifestyle. Interestingly, this behaviour is more common among

[1] The World Health Organization (2003a) estimates that obesity has reached epidemic proportions around the globe, with more than 1000 million overweight adults, at least 300 million of whom are obese.

[2] Cf. The reports of the International Obesity Task Force – IOTF (2002) and (2003).

[3] For instance, in the analyses carried out for the World Health Report 2002, approximately 58% of diabetes, 21% of ischaemic heart disease and 8-42% of certain cancers were attributable to a body mass index above 21 Kg/m^2.

female adults (52%) than among males (41%) and the share of the population that devotes more than 5 hours a week to sports is the second lowest in the EU, after Portugal.

In spite of this aggregate evidence, the determinants of obesity are relatively unknown. Among them, the social determinants are the ones that have been tested the least. Social determinants are frequently country-specific and often present highly complex interactions with social behaviour patterns. Empirical evidence shedding light on the impact of social interaction on body weight is crucial for the design of health policies such as information campaigns, promoting advice from doctors, and so on. Effective policies for controlling obesity require an understanding of the complex processes underpinning body mass composition which not only involve biological and genetic endowments but are associated with socio-economic, cultural and behavioural factors (Sundquist and Johansson, 1998 and Zhang and Wang, 2004). These studies identify income and ethnicity as responsible for a higher prevalence of obesity. Interestingly, there is an apparent inverse association between obesity and income in the US white population while it is just the contrary in minority groups. Socio-economic position is believed to affect attitudes towards food and body weight status (Cahnman, 1968). Other factors are time preference (Komlos et al, 2004) and the role of education (Nayga, 2001).

However, little empirical evidence has been gathered on the association between obesity and self-image. Individuals' social interactions may well be important in explaining their attitudes towards the development of their own body mass. Indeed, acknowledging the role of self-image implies focusing on the social nature of individual behaviour, and its effects on the production of body mass which might be regarded (to an extent) under individual control. Social interactions may lead to individual pleasures such as "the pleasure of being seen as having a shifted body" and individuals' desire for distinction inside their social environment may make this a factor when they consume food. Over the years many experts have acknowledged the role of social interaction in explaining human behaviour. Social interactions include the role of demonstration (Duesenberry, 1949) bandwagon and snob influences (Leibenstein, 1950) and more general interactions (Becker, 1974) However, they seem to have played a minor role in the economic analysis of individuals' body mass in spite of the fact that people's behaviour often aims to emulate that of others.

This paper presents an empirical evaluation of the determinants of obesity in Spain by examining the condition jointly with individuals' self-image. Social interactions are significant though endogenous determinants of obesity in

modern societies. Such as obesity, social interactions might capture some of the influencing part effect of the socio-economic determinants of obesity. The importance of social interactions is grounded on theoretical models of individual interactions (Becker, 1974). We develop an empirical model in which we correct the determinants of obesity with individuals' concern with their self-image. The results suggest that self-image is a significant predictor of individuals' body mass and also of obesity and overweight.

2. Social interactions and individual body mass

2.1 The conceptual model

As social animals, human beings interact in their daily lives in the pursuit of common social goals, which, we hypothesize, are to drive their physical appearance and ultimately, their social interactions. Everyone in the population is assigned a specific role guided by gender, education and lifestyle. According to Ackerloff and Kranton (2000), behavioural prescriptions ("social norms") affirm one's self-image within the social environment. If this self-image is violated, the result is anxiety and unease. Individuals choose who they want to be and adapt their behaviour accordingly. Therefore, social interactions determine individuals' preferences, and ultimately their behaviour at various levels, such as feeding, doing sport and dressing. Therefore, individuals' decisions regarding their social identity preclude to an extent their specific body mass. Although individual's weight is in part an endowment determined by genetics and specific human biology it is largely recognised to influence food intake. Therefore, putting on weight might be the result of an individual's decision (e.g., chosen lifestyle) which determines calorie intake and results in body mass generation. However, it may well be that individuals might have to face conflicting goals between satisfying their tastes –and thus consuming food at their full appetence– or refraining from following they appetence to allow their body shift in line with their desired identity. That is, some share of individuals in their daily decision making trade-off their own desired identity and their consumer preferences based on tastes. That is, food intake decisions are driven by individuals' willingness to adapt their body to a specific desired physical constitution.

Although the production of fat and the rise in the individuals' body mass are heavily dependent on individual biological constitution and lifestyle (e.g., the rate at which an individual burns calories), social interactions at certain ages may to an extent determine individuals' physical constitution. Some economists find explanations for obesity in the expanding food supply resulting from technological change (Philipson, 2001). However, looking at individuals in

developed societies one might well argue that social interactions, as determining the role each person plays at each point of the life cycle, are likely to preclude an uncontrolled development of body mass and obesity. In a recent paper Wansink (2004) argues that the eating environment, that is the ambient factors associated with the eating of food, but that are independent of food. Therefore, social interactions should be distinguished from the food environment or the factors that directly relate to the way food is provided or presented. Indeed, determining how much to eat or drink relies on consumption norms determining an acceptable quantity to eat. In addition, research finds that as the number of eating companions increases, the average variability of how much is eaten may actually decrease (Clendennen et al, 1994). However, this refers not to social interactions but to the fact that certain food environments might lead to increase the food intake. In fact what we suggest in this paper is that people who exhibit a more intense social life would be those that might hypothetically care about their self-image.

Individuals are assumed to choose an identity so that each person has a conception of his/her own categories and that of other people. *s*(.)* refers desired social self-image resulting from their social interactions which fit in some specific identity. Individual self-image leads to a desired body mass *h*(.)*; both enter the utility function. Both self-image (S) and individuals body mass (B) are determined by individual's income (y), variables proxying human capital such as education, experience and environmental variables (E) and other variables (Z). At any time, households allocate both time and economic resources to the production of commodities such as health and social interactions – both leading to a certain self-image and desired health. Thus, individuals maximise a joint utility function subject to technology and income constraints. That is, the individual j maximises its utility function:

$$U_j = U(h^*, s^*, Z_j)$$

$$h^* = h(B_j, Y_j, E_j) \quad (1)$$

$$s^* = s(S_j, Y_j, E_j) \quad (2)$$

$$s.t \quad p^s S_j + B_j \leq Y_j$$

where p^s refers to the price of social interactions and the price of a unit of body mass taken as a numeraire. Therefore, the individual's body mass (B) and social interactions (S) will be:

$$B_j = b(E_j, Y_j, S_j, Z_{1j}) \quad (3)$$

$$S_j = s(E_j, Y_j, B_j, Z_{2j}) \quad (4)$$

That is, social interactions and the individual's body mass are inversely associated in so far as they both compete for the allocation of income and time. One potential issue for the simple model is that it does not take into account the time dimension, as far as we are concentrating in the contemporaneous consequences of obesity. Therefore, we do not examine the fact that obese people will live shorter lives but concentrate on what determined the onset of obesity rather than the potential effects on mortality.

2.2 The empirical specification

According to the conceptual framework, both individual body mass and individuals concern with their self- image are potentially endogenous variables which might be subjected to significant interactions in both ways. Thus, in analysing the determinants of obesity one of the not yet well understood issues refers to the role of potential endogenous variables, mostly from individuals' decisions regarding their own lifestyle and nutrition variables. Therefore, individuals may self-select their own body mass by investing in the pursue of their desired self-image. To examine this issue we will estimate the determinants individuals body mass, obesity and overweight using a sample selection procedure proposed by Heckman (1979). Heckman's sample selection model is based on the following two latent variable models:

$$\begin{aligned} B &= \beta' X + \mu_1 \text{ if } (S = 1) \\ S &= \delta' Z + \mu_2 \end{aligned} \qquad (5)$$

where X is a k-vector of regressors, Z is an m-vector of regressors and the error terms u_1 and u_2 are jointly normally distributed, independently of X and Z, with zero expectations. B refers to body mass – as well as obesity or overweight – and S refers to social interactions. Furthermore, because we treat self-image as an endogenous variable, $u_1 \sim N(0,\sigma)$ and $u_2 \sim N(0, 1)$ and $corr(u_1, u_2) = \rho$, when ρ refers to the correlation between the error terms of the two processes. If the correlation terms takes the value zero, both models can be estimated separately, but if they are not they should be estimated jointly. Furthermore, the latent variable S itself is not observable –only its sign. Therefore, we observe a positive value if social interactions take place and zero otherwise. The same applies to obesity and over (under) weight. In the remaining case, instead of an OLS model to estimate B, we use a two stage probit model estimated using maximum likelihood (Van der Ven and Van der Praag, 1981).

3. Data and Variables

3.1 The data

The database used in this study is the European Community Household Panel (ECHP), wave 5, survey year 1998, for Spain. This is a specific, longitudinal EU survey designed by Eurostat to supply information on household and individual income. The ECHP contains rich information on several sources of income (including social transfers), and also on labour market variables, housing, health and other socio-economic indicators concerning the living conditions of private households and persons. After deleting some missing values our sample comprised 12,591 individuals aged 16 to 89 years old, of whom 6,143 (48.8%) are men and 6,448 (51.2%) women.

To assess the prevalence of overweight and obesity in the data we use the widely accepted Body Mass Index (BMI) indicator, which is defined as weight in kilograms divided by the square of height in metres (kg/m^2). According to the World Health Organization classification, a BMI over 25 kg/m^2 is defined as overweight, and a BMI of over 30 kg/m^2 as obese; BMI below 18.5 kg/m^2 is considered underweight. However, within the obese category a value below 35 is considered as moderate, between 35-40 is classified as severe and over 40 as extreme. Table 2 provides a description of the data labels and descriptive means.

Central to our investigation are individual social interactions. Given the difficulties to measure empirically this variable we decided to proxy it through the use of the question of how often respondents meet friends or relatives not living with them. Social interaction refers to the intensity of an individual's social life. A positive association is assumed between the ability of an individual to meet people and their self-image. This variable has five categories ranging from a score of one if individuals answer "on most days" to five if the answer is "never".[4]

Another key variable in our regressions is the natural logarithm of individual income which is constructed from information on the total net household income declared by each interviewee. Specifically, we derive per adult equivalent income by deflating net household income by the OECD equivalence scale, which allows for differences in size and demographic composition of the household.[5] Educational level of respondents was calculated

[4] We recoded this variable since a value of 1 means that the individual responds "on most days" or "once or twice a week" and 0 otherwise ("once or twice a month", "less often than once a month" or "never").

[5] This equivalence scale adopts a value of one for the head of the household, 0.7 for other adults and 0.5 for those younger than 14 years old.

using information on the highest level of general or higher education completed. This is a dummy variable with a code of 1 for those who finished higher education, a code of 2 for the second stage of secondary education and a code of 3 for individuals who completed the first stage of secondary education (or less).

This investigation also analyses the existence of geographical variations in the prevalence of obesity. However, the survey provides too aggregate information since the question on the location of the household is measured in NUTS aggregates. For Spain seven regions are considered: Region 1, Galicia, Asturias and Cantabria; Region 2, the Basque Country, Navarre, La Rioja and Aragon; Region 3, the Community of Madrid; Region 4, Castile and Leon, Castile and La-Mancha; Region 5, Catalonia, Valencia and Balearic Islands; Region 6, Andalusia and Murcia and Region 7, the Canary Islands. Other independent variables investigated are gender, age, marital status, household size and the cross relations between them.

3.2 Preliminary Evidence

Table 2 displays the means and standard deviation as well as the definition of the variables used in this study. These preliminary data show that 12.6% of total respondents are obese, 34.4% are overweight while the remaining 50% of respondents are within their recommended weight range. These figures suggest that, as pointed out in the introduction, Spain is part of the obesity epidemic but is not a country in which obesity is highly prevalent. In addition, obesity is associated to specific characteristics as age and gender. Interestingly, while obesity displayed no significant gender difference, approximately 42% of men are overweight and this figure is just 27.3% in the case of women. Almost 5% of women are under their normal weight; this feature is negligible in men, below 1%. It is also worth noting that age raises the prevalence of obesity: the percentage of obese younger than 30 years old is around 7.4%, but around 43% for those at age 60 and older.[6] In other words, in the 50-79 year age group obesity ranges from 19.7% to 22.3%, well above the average of the entire dataset (12.6%), and the prevalence of overweight averages 46%, higher than the sample average, 34.4%.

Socio-economic variables are also relevant explanatory factors. For instance, among the unemployed (9% of the total sample) the share of both obese and overweight (34%) was significantly below the average (47%). At the same time, the prevalence of recommended weight (a BMI between 18.5 and 25 kg/m^2) was 61.4%, well above the average value of 50%. However, in the category "working more than 15 hours per week" (41.4% of sample) and the

[6] Similarly, 14.6% of the overweight are below 30; this figure is 35% for the over-60s.

"economically inactive" group (47.8%) the proportion of obese and overweight was equivalent to that of the total sample. This suggests that individuals' demand for leisure may be associated to the probability of obesity. The longer the leisure time, the more likely individuals are to care for and be aware of their own body. In addition, the unemployed are effectively seeking to attract the attention of potential employers and as a result may take more take of their physical appearance.

Marital status and education also have a notable effect on body mass. In general, there is a casual association between being married and weight gain, possibly though its relation with child bearing. Our data seem to confirm this, given that the proportion of married obese (15.2%) and overweight (40.7%) categories are again higher than in the average sample. Similarly, among obese individuals (overweight) close to 71% (70%) are married, a figure that is much higher than that of married individuals in the sample (59%). On the other hand, our data indicate that obesity is negatively related to education. The share of obesity in respondents who completed higher education is just 5.7% and the rate for those who finished secondary education is 7%, well below the average.

Finally, an interesting regional pattern also emerges for obesity in our dataset.[7] Surprisingly, the prevalence of obesity is relatively high in the south (Andalusia and Murcia) and the Canary Islands (15.4%), compared with a prevalence of just 8.2% in the Autonomous Community of Madrid.

4. Results

The empirical strategy of this study is to estimate the predictor of individuals' social interactions along with the production of body mass, obesity and overweight. In addition to the variables in Table 2, we include interaction effects in our model to capture the possible non-linearities that some variables might exhibit in determining both individuals' weight and social interactions. Table 3 examines the determinants of the body mass index accounting for the selectivity of social interactions. Table 4 examines a sample selection model for obesity and Table 5 for overweight. In all models, Log Likelihood tests for the independence of the two processes rejected the null hypothesis of independence as the Mills Lambda was significant at a level of 5%. In addition, the correlation coefficient of the error terms of the processes is negative, suggesting that social interaction might make individuals 'fitter', and thus less obese and overweight.

[7] Unfortunately, the ECHP only offers information at a regional aggregate basis (NUTS1 aggregates).

As expected, males had higher body mass, though when the interaction effect was included it was more affluent middle-aged men who presented the highest body mass. Interestingly, both age and income displayed a quadratic effect, suggesting in the first case that people may be presumably induced to lose weight when older and that richer individuals are more likely to invest on their self-image so that they adapt their body mass better to the one that is desired. Education and regional dummies are used as observation variables. Those that have been married at some point - divorced, widowed or separated – and those currently married are more likely to display a higher body mass than those who have never married; this is especially the case of married males. The results were robust regardless of the specification.

Social interactions are explained by age; older individuals are more likely to devote time to social interactions, especially if married (Table 3). Interestingly, gender is never an explanatory variable for social interactions while education is positively associated with social interactions, and this is especially the case of married low educated individuals who are predicted to be less likely to be involved with others. Household size is inversely associated with social interactions. A possible explanation might be that the larger the household the less likely individuals are to meet others outside the household. Similarly, in explaining social interactions, individuals in southern and Mediterranean regions are more likely to interact with others. The high significance of the variable household size and the non-linear effect with age suggest that social life declines due to fertility, which in turn has an effect on obesity. These effects coexist with human capital effects, in so far as low educated individuals who are married are more likely to be obese.

Looking at specific determinants of obesity in Table 4 we find that men, consistently with the results in Table 3, are more likely to be obese than women. Again, income has a non-linear effect: middle-income individuals tend to have a higher body mass. The same non-linear effect applies to age: individuals' age increases obesity, but at a certain age it starts to decrease. This is consistent with the assumption of time preference as determining individuals' body mass (Komlos et al, 2004). The separated, divorced and widowed are more likely to be obese than married subjects. Introducing interaction terms we find that being married male are more likely to be obese. On the other hand, younger women have a lower body mass while and that more affluent men are likely to have a higher body mass. Sedentary lifestyle was no longer significant when interaction terms were included.

Table 5 displays the two-stage sample selection model for overweight. It is worth noting that compared to obesity and body mass estimates, age has a quadratic effect on overweight, and income is not a significant predictor.

However, marital status remains an important determinant of overweight, which interacts with age and gender. Relatively richer men as well as older women are more likely to be overweight. This result suggests that social determinants of overweight, among them income, may be less explanatory in determining whether an individual's weight is above the ideal. Again it is age that shifts individuals' weight down. This may be consistent with the idea that time preferences determine individuals' weight. If age slows down time preference then we would expect older individuals to experience higher 'preference for the future'.

5. Conclusions

This paper has sought to examine the determinants of individuals' body mass, obesity and overweight in connection with individual social interactions. Results from several sample selection models suggest that social interactions enable individuals to compare themselves with each other, and encourage behaviours that might prevent obesity and overweight. Interestingly, our results highlight the significance of regional variables and marital status as well as household size. Therefore, in the light of our findings we can suggest that social interactions, which are found to determine social image, may also explain the differences in obesity among European countries, which is an issue that to date remains relatively unexplored. Our results may be considered as surprising in suggesting that obesity might be a social phenomenon connected to individuals' social life and that by promoting social interactions, individuals may change their own self-image, or in the terms of Akerloff and Kranton (2000), their desired identity. However, we should note that due to data limitations the study does not include relevant variables connected with individual's lifestyles such as food intake, smoking and drinking habits along with sport practice.

In agreement with these findings, we observed that income and age display a non-linear effect in determining obesity. Arguably, these effects suggest that obesity is concentrated in middle income individuals, which suggests that is not the lower social position that determines obesity or, at least, that other factors are also at work. Interestingly, our estimates suggest that obesity is more likely in married men and less likely in young women. Overweight is more likely in high income men and less likely in younger women, as well as relatively older individuals who declare as being married. One may cast some doubts on the relationship between obesity and income resulting from possible labour market discrimination. However, if this is the case, because unemployed in Spain receive a public subsidy, we should find that obesity is determined by low income groups which is not the case. This doesn't

imply that there might still be labour discrimination in the Spanish labour market.

Our results should be interpreted with some caution since certain relevant individual variables are not included explicitly in our model such as interactions between health and time preference. Other caveats refer to the way we measure social interactions. Our survey only contained a variable for individuals' social life and may overlook other social interactions. An important caveat that should be noted is the fact that we do not look at the long run effects of obesity, and thus our model does not maximize utility over the lifetime. This means we do not consider the fact that obese people will live shorter lives. Therefore, one might argue that one of the consequences of obesity is that the onset of some illnesses happens before non-obese population, being that the reason for an association between social interactions and obesity. However, we found a similar casual relationship for those overweight which provide some evidence that the pattern identified is not exclusively a specific influence of obesity related health effects. On the other hand, some other concern might rely in the interpretation of the causality of our results. For instance, one might argue that obese people may find it more difficult to find friends, which implies that equation (2) might need to be reinterpreted as the feasible self-image rather than the one individual's desire. Finally, it should be acknowledge the existence of significant unobserved heterogeneity in the sort of data examined. This might place some effects on the relationship between obesity and social interactions. For instance, although we find that the relationship is guided by some sort of substitution, it might well be that for some individuals both are complements. However, the latter would mainly refer to the environmental determinants of food intake while the former would refer to the social interactions as influencing body shape.

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Table1. Prevalence of obesity in some EU member states

EU Country	Obese men (in %)	Obese women (in %)
Belgium	12.1	18.4
Denmark	10	9
France	9.6	10.5
Germany	17.2	19.3
Italy	6.5	6.3
Netherlands, The	8.4	9.3
Spain	11.5	15.2
Sweden	10	11.9
UK	17	20

Source: International Obesity Task Force, 1999.

Table 2. Variable description and means

Variable	Description	Mean (N = 12,591)	Std. Dev. (N = 12,591)
Dependent variables			
Log of BMI [a]	Log of body mass index	3.21	0.163
Obese	1 if individual is obese, 0 otherwise	0.126	0.332
Overweight	1 if individual is overweight, 0 otherwise	0.344	0.475
Self-image	1 if indiv. meets friends or relatives not living with him/her very/quite often; 0 otherwise	0.9249	0.263
Independent variables			
Gender	1 if men; 0 if women	0.488	0.499
Age	Age in years	44.99	19.27
Age_square	Square of age in years	2395.36	1901.21
Log of Income [b]	Log of total net equivalent income	13.67	0.886
Square of Log of Inc.	Square of log of total net equiv. income	187.73	21.01
Married	1 if married; 0 otherwise	0.5883	0.492
Sep./Div./Widowed	1 if separated, divorced or widowed; 0 otherwise	0.1056	0.307
Single	1 if never married; 0 otherwise	0.3061	0.461
NutsReg_1	1 if indiv. lives in Nuts 1 (Galicia, Asturias and Cantabria); 0 otherwise	0.1282	0.334
NutsReg_2	1 if indiv. lives in Nuts 2 (Basque Co, Navarre, La Rioja and Aragon); 0 otherwise	0.1471	0.354
NutsReg_3	1 if indiv. lives in Nuts 3 (Comm. of Madrid); 0 otherwise	0.0943	0.292
NutsReg_4	1 if indiv. lives in Nuts 4 (Castie-Leon, Castile-La Mancha and Extremadura); 0 otherwise	0.1587	0.365
NutsReg_5	1 if indiv. lives in Nuts 5 (Catalonia, Valencia, I. Baleares); 0 otherwise	0.2154	0.411
NutsReg_6	1 if ind. lives in Nuts 6 (Andalucia and Murcia); 0 otherwise	0.1900	0.392
NutsReg_7	1 if indiv. lives in Nuts 7 (Canarias); 0 otherwise.	0.064	0.392
Education_1	1 if indiv. completed 3rd. level of education, 0 otherwise	0.1749	0.379
Education_2	1 if indiv. completed the second stage of secondary education; 0 otherwise	0.1901	0.392
Education_3	1 if indiv. completed less than the second of secondary education; 0 otherwise	0.6343	0.482
Household size	Size of the household	3.625	1.536
Age*Gender	Age multiplied by variable gender	21.404	25.538
Age*Income	Age multiplied by variable income	616.558	268.902
Age*Married	Age multiplied by variable married	29.302	27.189
Age*(Sep./Div./Wi)	Age multiplied by variable separated, divorced and widowed		

[a] BMI variable is measured as weight in kilograms divided by the square of height in meters (kg/m^2).

[b] Equivalent income is measured as household income divided by the OECD equivalence scale.

Table 3. Regression Model with Sample Selection (Two Step Estimation) for Log of BMI

	Log of BMI (N=12,526)		**Log of BMI (N=12,526)**	
	Coefficient	Std. Error	Coefficient	Std. Error
Intercept	2.7600**	0.0525	2.6561**	0.0818
Gender	0.0674**	0.0033	-0.0541	0.0442
Age	0.0117**	0.0006	0.0122**	0.0017
Age Square	-9.0E-05**	5.74E-06	-9.0E-05**	5.83E-06
Log of Income	0.0302**	0.0084	0.0394**	0.0098
Sq. of Log of Income	-0.0016**	0.0004	-0.0020**	0.0004
Married	0.0224**	0.0049	0.1761*	0.0596
Sediwi	0.0434**	0.0074	0.0914	0.1019
NutsReg_2	-0.0045	0.0072	0.0084	0.0060
NutsReg _3	-0.0068	0.0074	-0.0100	0.0063
NutsReg _4	-0.0107	0.0075	-0.0073	0.0062
NutsReg _5	-0.0142*	0.0067	-0.0117*	0.0055
NutsReg _6	0.0015	0.0075	0.0054	0.0061
NutsReg _7	-0.0093	0.0097	-0.0048	0.0079
Age*Gender			-0.0026**	0.0002
Age*Income			2.88E-05	1.0E-05
Age*Married			0.0002	0.0003
Age*Sediwi			0.0004	0.0004
Gender*Income			0.0164**	0.0032
Married*Income			-0.0118*	0.0043
Sediwi*Income			-0.0063	0.0074
Gender*Married			0.0162*	0.0076
Gender*Sediwi			0.0124	0.0134
	Social-interactions		**Social-interactions**	
Intercept	2.2738**	0.1487	2.3375**	0.1762
Gender	-0.0377	0.0347	-0.1186	0.0995
Age	-0.0222**	0.0060	-0.0251**	0.0070
Age Square	0.0001*	5.61E-05	0.0001	7.03E-05
Education_1	-0.1006*	0.0479	-0.0093	0.1428
Education_2	0.0002	0.0506	0.1446	0.1363
Married	0.0148	0.0533	-0.1089	0.1631
Sediwi	-0.1085	0.0735	-0.0151	0.3175
Household size	-0.0495**	0.0115	-0.0531**	0.0117
NutsReg _2	-0.1947**	0.0580	-0.2025**	0.0583
NutsReg_3	-0.1403*	0.0660	-0.1416*	0.0644
NutsReg_4	0.2472**	0.0640	0.2418**	0.0644
NutsReg_5	0.1762*	0.0584	0.1672*	0.0588
NutsReg_6	0.2780**	0.0620	0.2741**	0.0623
NutsReg_7	0.3533**	0.0903	0.3465**	0.0907
Age*Gender			0.0033	0.0022
Age*Married			0.0069*	0.0029
Age*Sediwi			0.0028	0.0048
Gender*Married			-0.1166	0.0925
Gender*Sediwi			-0.0287	0.1563
Education_1*Age			0.0022	0.0038
Education_2*Age			-0.0008	0.0040
Education_1*Married			-0.2742*	0.1187
Education_2*Married			-0.1560	0.1277
Education_1*Sediwi			0.2065	0.3058
Education_2*Sediwi			-0.2948	0.2258
Mills Lambda	-0.1756**	0.0436	-0.1129*	0.0527
	Wald Chi2 (24) = 2,185.61		Wald Chi2 (38) = 3,067.67	

* Statistically significant at the 0.05 level; ** Statistically significant at the 0.01 level

Table 4. Selectivity corrected probit models

	Obese (N=12,526)		**Obese (N=12,526)**	
	Coefficient	Std. Error	Coefficient	Std. Error
Intercept	-3.2218**	0.4003	-4.2382**	0.9091
Gender	0.1081**	0.0277	0.1221	0.4168
Age	0.0586**	0.0054	0.0668**	0.0152
Age Square	-0.00004**	5.0E-05	-0.0005**	6.51E-06
Log of Income	0.1783*	0.0612	0.2495*	0.0963
Sq. of Log of Income	-0.0097**	0.0027	-0.0112**	0.0031
Married	0.0557	0.0439	0.9382	0.6104
Sediwi	0.2033**	0.0593	0.7695	0.9183
NutsReg_2	0.0366	0.0521	0.0341	0.0544
NutsReg_3	-0.0104	0.0609	-0.0253	0.0637
NutsReg_4	-0.1088*	0.0515	-0.1041*	0.0533
NutsReg_5	-0.0387	0.0482	-0.0344	0.0500
NutsReg_6	0.0170	0.0504	0.0245	0.0536
NutsReg_7	-0.0153	0.0662	-0.0028	0.0693
Age*Gender			-0.0118**	0.0020
Age*Income			3.66E-05	0.0011
Age*Married			0.0009	0.0025
Age*Sediwi			0.0016	0.0038
Gender*Income			0.0322	0.0300
Married*Income			-0.0721	0.0444
Sediwi*Income			-0.0545	0.0659
Gender*Married			0.1731*	0.0799
Gender*Sediwi			0.1036	0.1260
	Social-interactions		**Social-interactions**	
Intercept	2.2722**	0.1414	2.4272**	0.1718
Gender	-0.0174	0.0349	-0.1471	0.0993
Age	-0.0235**	0.0059	-0.0296**	0.0069
Age Square	0.0001*	5.61E-05	0.0001*	7.03E-05
Education_1	-0.2115**	0.0397	-0.1844	0.1244
Education_2	-0.0886*	0.0428	0.0121	0.1220
Married	-0.0072	0.0529	-0.1026	0.1552
Sediwi	-0.1069	0.0727	-0.1136	0.3055
Household size	-0.0290*	0.0096	-0.0337**	0.0104
NutsReg_2	-0.1855*	0.0576	-0.1894**	0.0579
NutsReg_3	-0.1111	0.0660	-0.1156	0.0664
NutsReg_4	0.2412**	0.0640	0.2394**	0.0641
NutsReg_5	0.1837*	0.0581	0.1768*	0.0584
NutsReg_6	0.2645**	0.0619	0.2638**	0.0623
NutsReg_7	0.3546**	0.0900	0.3547**	0.0903
Age*Gender			0.0038	0.0022
Age*Married			0.0061*	0.0029
Age*Sediwi			0.0007	0.0047
Gender*Married			-0.0981	0.0915
Gender*Sediwi			-0.0186	0.1573
Education_1*Age			0.0041	0.0032
Education_2*Age			-0.0002	0.0033
Education_1*Married			-0.2850*	0.1018
Education_2*Married			-0.0980	0.1088
Education_1*Sediwi			0.0108	0.2806
Education_2*Sediwi			-0.2892	0.1907
ρ	-0.9484**	0.0367	-0.9304	0.0584
	Wald Chi2 (13) = 427.82		Wald Chi2 (22) = 401.63	
LL ratio	-7,261.135		-7,219.809	

* Statistically significant at the 0.05 level; ** Statistically significant at the 0.01 level

Table 5. Selectivity corrected probit models

	Overweight (N=12,526)		**Overweight (N=12,526)**	
	Coefficient	Std. Error	Coefficient	Std. Error
Intercept	-1.8082**	0.3926	-0.9873	0.7118
Gender	0.4067**	0.0240	-1.0622*	0.3806
Age	0.0509**	0.0041	0.0437*	0.0142
Age Square	-0.00004**	3.97E-05	-0.0004**	4.95E-05
Log of Income	-0.0285	0.0623	-0.0940	0.0824
Sq. of Log of Income	0.0011	0.0027	-0.0007	0.0030
Married	0.1572**	0.0360	0.7226	0.5218
Sediwi	0.1541*	0.0521	-0.0475	0.8842
NutsReg_2	0.0167	0.0441	0.0087	0.0464
NutsReg_3	0.0551	0.0500	0.0561	0.0515
NutsReg_4	-0.0435	0.0436	-0.0312	0.0455
NutsReg_5	-0.0878*	0.0410	-0.0774	0.0423
NutsReg_6	-0.0390	0.0421	-0.0264	0.0441
NutsReg_7	-0.1055	0.5664	-0.0899	0.0585
Age*Gender			-0.0110**	0.0016
Age*Income			0.0013	0.0010
Age*Married			-0.0079**	0.0021
Age*Sediwi			-0.0020	0.0034
Gender*Income			0.1397**	0.0282
Married*Income			-0.0215	0.0380
Sediwi*Income			0.0052	0.0639
Gender*Married			0.1270	0.0671
Gender*Sediwi			0.0510	0.1119
	Social-interactions		**Social-interactions**	
Intercept	2.2430**	0.1435	2.3785**	0.1718
Gender	-0.0253	0.0347	-0.1330	0.0995
Age	-0.0219**	0.0058	-0.0264**	0.0069
Age Square	0.0001*	5.53E-05	0.0001*	7.03E-05
Education_1	-0.1537**	0.0442	-0.0732	0.1348
Education_2	-0.0428	0.0469	0.0784	0.1302
Married	0.0009	0.0515	-0.1273	0.1601
Sediwi	-0.1177	0.0725	-0.0330	0.3135
Household size	-0.0404**	0.0105	-0.0476**	0.0115
NutsReg_2	-0.1953*	0.0575	-0.2015*	0.0581
NutsReg_3	-0.1462*	0.0656	-0.1406*	0.0663
NutsReg_4	0.2358**	0.0638	0.2357**	0.0643
NutsReg_5	0.1703*	0.0582	0.1664*	0.0587
NutsReg_6	0.2692**	0.0616	0.2692**	0.0622
NutsReg_7	0.3633**	0.0896	0.3571**	0.0909
Age*Gender			0.0034	0.0022
Age*Married			0.0071*	0.0029
Age*Sediwi			0.0030	0.0048
Gender*Married			-0.0974	0.0925
Gender*Sediwi			-0.0153	0.1563
Education_1*Age			0.0032	0.0036
Education_2*Age			-0.0005	0.0037
Education_1*Married			-0.3055*	0.1124
Education_2*Married			-0.1240	0.1214
Education_1*Sediwi			0.1373	0.3006
Education_2*Sediwi			-0.1933	0.2138
ρ	-0.9637**	0.0554	-0.8148	0.1400
	Wald Chi2 (13) = 1,094.00		Wald Chi2 (22) = 840.71	
LL ratio	-10,132.94		-10,028.98	

* Statistically significant at the 0.05 level; ** Statistically significant at the 0.01 level.

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