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SOCIOECONOMIC, HEALTH AND BEHAVIOURAL DETERMINANTS OF OBESITY IN EUROPE

Agelike Nikolaou [*] ***& Dimitrios Nikolaou*** [**]

Abstract: *In this study we investigate the impact of various socioeconomic, health and behavioural conditions on the prevalence of obesity in nine EU countries using the "European Community Household Panel" Dataset. The effect of those factors on obesity is estimated separately for males and females using a model that follows the standard normal cumulative density function (probit). Our findings indicate that low socioeconomic profile as well as bad health leads to a higher body mass, while smokers are less likely to be obese. These findings follow more or less an analogous trend for the nine European countries and hold for both sexes, appearing, though, to be more consistent for the females.*

JEL Classifications: *C23, I12, I18*

Keywords: *obesity, socioeconomic status, panel data*

INTRODUCTION

Obesity is one of the greatest public health challenges of the 21st century. According to the OECD Health Data (2005), its prevalence has tripled in many countries in the European continent since the 1980s, and the numbers of those affected continue to rise at an alarming rate. The International Obesity Taskforce (2002) has recorded that 135 million citizens in the European Union are affected. Worldwide, the prevalence of obesity ranks USA in the first place, followed by Mexico and United Kingdom.

The existing literature concerning the relationship between obesity and socioeconomic status (SES) confirms the fact that a lower socioeconomic condition is associated with a greater Body Mass Index or BMI (Sobal and Stunkard, 1989; McLaren, 2007). Reducing the prevalence of obesity as well as SES inequalities connected with premature death and disability from obesity, is a high priority of EU's public health agenda.

Three of the most commonly used indicators of SES are education level, employment status and economic conditions. To begin with, education is related with the acquisition of knowledge and beliefs; consequently, greater educational attainment means higher perception of the conditions which are beneficial (Sarlio-Lähteenkorva and Lahelma, 1999; Wardle *et al.*, 2002; Laaksonen *et al.*, 2004). Women in high-level occupational status are less likely to be obese

[*] Department of Economics, University of Macedonia, 146, Egnatia Str, 54006, Thessaloniki, Greece, *E-mail: agelike@uom.gr*

due to pressure on them to preserve a specific image (Van Lenthe *et al.*, 2000; Wardle and Griffith, 2001; Sarlio-Lähteenkorva *et al.*, 2004). Low status in employment can be translated into more strenuous physical work which is against obesity, with that tendency being characteristic of men (Wardle *et al.*, 2002). In general, occupation has a negative effect for women, whereas for men it lacks significance (Martikainen and Marmot, 1999; Laaksonen *et al.*, 2004; Sarlio–Lähteenkorva *et al.*, 2004; McLaren, 2007).

Furthermore, the effect of income on obesity seems to be inconclusive. For example, there is a claim that income is responsible for a higher prevalence of obesity mainly for the male group (Sundquist and Johansson, 1998; Van Lenthe *et al.*, 2000; Zhang and Wang, 2004) and adversely, that affluent individuals are more likely to invest on their appearance, meaning that they can adapt their body mass better to the desired level (Costa-Font and Gil, 2004). Analogously, low income may be associated with obesity (Paeratakul *et al.*, 2002). The negative link between high income and obesity stems from the fact that income affects the resources of a household, which in turn specifies the quality of the bought food. The positive connection has to do with the finding that obesity is determined by other factors, as well (McLaren, 2007). Researchers have used a number of different indicators to approximate either the wealth or the poverty of a specific household or individual. As an indication of wealth, home and car ownership or any other luxuries in the household can be used. Lack of basic commodities, allowance of social benefits or the level of economic difficulties can be thought as an indication of poverty (Sarlio-Lähteenkorva and Lahelma, 1999; Laaksonen *et al.*, 2004).

Only during the last decades the literature started to examine the linkage between obesity and health. As a measure of health they have selected, mainly, specific diseases or the self-assessed health condition. The existing literature confirms the positive relationship among high BMI and higher risk of specific diseases (Sundquist and Johansson, 1998; Paeratakul et al., 2002), while empirical works based on self-assessed health condition reveal an inverse association of perceived bad health with obesity, especially for women (Sundquist and Johansson, 1998; Lahti-Koski *et al.*, 2002; Mohammad Ali and Lindström, 2005; Bolin *et al.*, 2006; Cantanero and Pascual, 2007). Closely related to the above measures is the lifestyle which an individual adopts. Most findings suggest a negative relationship between smoking and obesity (Molarius *et al.*, 1997; Sundquist and Johansson, 1998; Martikainen and Marmot, 1999; Rodriguez Artalejo *et al.*, 2002), as well as between smoking and physical activities (Sundquist and Johansson, 1998; Martikainen and Marmot, 1999; Mohammad Ali and Lindström, 2005).

Few are the studies which have analyzed the impact of socioeconomic characteristics and health status on obesity in the case of the European Union (Sundquist and Johansson, 1998; Martikainen and Marmot, 1999; Lahti-Koski *et al.*, 2002; Mohammad Ali and Lindström, 2005). Even less are those studies which are based on the European Community Household Panel (ECHP). Most of these studies focus on one country from the pool of the fifteen available European countries in the ECHP, use cross-section analysis or limit the number of the explanatory variables (Costa-Font and Gil, 2004; Sanz-de-Galdeano, 2005; Cantanero and Pascual, 2007). Therefore, the main aim of this paper is to investigate as thoroughly as possible, the factors which may exert a significant influence on obesity in as many European countries as possible in a longitudinal setting by using a reliable dataset.

METHODS

Data and Variables

The dataset employed in this paper originates from the European Community Household Panel (ECHP UDB-version of December 2003). The survey contains sample information about the individual characteristics, such as income, housing, education, health, employment, immigration and the like, for the period 1994-2001.

However, despite the fact that the dataset contains information for eight years and for fifteen countries, due to data limitations, we can make use only of a four-year period and nine countries. The sample is limited to Austria, Belgium, Denmark, Finland, Greece, Ireland, Italy, Portugal and Spain covering the period 1998–2001. It consists of 291,162 individuals, 140,470 (48.24%) of whom being men and the remaining 150,692 being women (51.76%). A percentage of 10.1% is characterized as obese while the majority of these individuals are females (52%).

It is widely accepted that the use of height or weight as dependent variables, may lead to biased outcomes. The World Health Organization has proposed the use of the BMI, which takes into account both measures. More precisely, the BMI index is given by the relation *weight* [*kg*] */height*^{2} [m^2] and according to the value it takes, it distinguishes among the states of underweight, normal weight, overweight or pre-obese, and obese. Since obesity is the focus of this paper, only BMI values greater than 30 are considered. A number of explanatory variables (demographic, behavioural, socioeconomic, and health) are used on which further details are presented in tables I and II.

Statistical Analysis

Since the dependent variable differentiates between two possible situations (obese, non-obese), a bivariate decision model is more appropriate. Therefore, our dependent variable is in fact modelled as a probit model. At the same time, besides the measurable characteristics in the sample, there are other features of interest that cannot be observed. If someone neglects the heterogeneity among the individuals, then the estimators will not be consistent. In order to take into account the unobserved heterogeneity, it is necessary to determine the connection between the independent variables and the unknown characteristic of each individual in the sample (a_i). Under the assumption that a_i and u_{it} are normally and identically distributed independently from the set of the x_{it} variables, and thus $Cov(a_i, x_{it}) = 0$, a random effects probit model is obtained: $y_{it}^* = x_{it}'\beta + \alpha + (u_{it} + \sigma_\alpha \nu_i) = (\alpha + \sigma_\alpha \nu_i) + x_{it}'\beta + u_{it} = \alpha_i + x_{it}'\beta + u_{it}$. For comparisons between different groups of the same population, the marginal effects are more suitable. These effects express how the probability of being obese changes due to a slight change in an independent variable (Greene, 2003).

The analysis is stratified according to the gender of each individual. In order to examine if the health of an individual affects significantly the dependent variable as well as if it alters the impact of the other independent variables on obesity, five specifications for each sex group are set. The first specification contains only socio-economic indicators while in the second step the smoking status of each respondent is added. In the third model, the impact of the Self-Assessed Health Status (SAHS) is examined, which is replaced in the fourth model by the existence of

Table I
Definition of Variables

Variables	*Definitions*
Obese	Dummy equal to 1 if respondent has a body mass index greater than 30, 0 otherwise
Age group 30-44	Dummy equal to 1 if respondent is between 30 and 44, 0 otherwise
Age group 45-54	Dummy equal to 1 if respondent is between 45 and 54, 0 otherwise
Age group 55-64	Dummy equal to 1 if respondent is between 55 and 64, 0 otherwise
Age group 65 +	Dummy equal to 1 if respondent is 65 years of old or older, 0 otherwise
Married	Dummy equal to 1 if respondent is married, 0 otherwise
Div/Sep/Wid	Dummy equal to 1 if respondent is divorced, separated or widowed, 0 otherwise
Primary Education	Dummy equal to 1 if respondent is of basic education, 0 otherwise
Middle Education	Dummy equal to 1 if respondent is of middle education, 0 otherwise
Employed	Dummy equal to 1 if respondent is employed, 0 otherwise
Self-employed	Dummy equal to 1 if respondent is self-employed, 0 otherwise
Unemployed	Dummy equal to 1 if respondent is unemployed, 0 otherwise
House size	Number of members into a specific household
Some economic difficulties	Dummy equal to 1 if respondent estimates that his economic problems are valued with 3 or 4 in a six-rank scale, 0 otherwise
Frequent economic difficulties	Dummy equal to 1 if respondent estimates that his economic problems are valued with 5 or 6 in a six-rank scale, 0 otherwise
Income	Natural logarithm of equivalized household income
Home owner	Dummy equal to 1 if respondent has his own house in his possession, 0 otherwise
Poverty index	Index taking values from 13 to 26, based on the dearth of bath, separate kitchen, indoor toilet, heating, terrace, hot running water, enough light, impermeable roof and solid floors
Social interaction	Index about the frequency of talking to and meeting with friends ranging from 2 to 6
Luxury index	Index varying from 8 to 24 according to the existence of colour TV, video recorder, microwave, dishwasher, personal computer
Dependent children	Dummy equal to 1 if respondent has a child under the age of 15, 0 otherwise
Smoker	Dummy equal to 1 if respondent is a current smoker, 0 otherwise
Bad health	Dummy equal to 1 if respondent perceives his health as very bad or bad, 0 otherwise
Fair health	Dummy equal to 1 if respondent perceives his health as fair, 0 otherwise
Chronic problem	Dummy equal to 1 if respondent is suffering from a physical or mental chronic problem, 0 otherwise
Year	Dummies indicating each year are imported in the regression models covering the period 1998-2001, leaving 1998 as the reference year

[a] The reference group for the dependent variable is the non obese population, for age group is 16-29 group, for the marital status are the singles, for education level is the tertiary education, for employment status is the inactive part, for the degree of economic difficulties is the no economic difficulties, for home ownership are the renters, for children is the lack of dependent children, for smoking status are the non-smokers, for general health condition is the good self-assessed health status and for chronic problems is the group who does not suffer from a chronic problem.

Table II
Percentages and Means of Main Variables for the Whole Population

Variables/Countries	*Austria*	*Belgium*	*Denmark*	*Finland*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*
Part A –Percentages of Dummy Variables									
Age group 17-29	23.69	19.19	21.21	24.59	22.47	27.45	24.25	25.86	26.45
Age group 30-44	26.76	32.25	30.76	27.23	24.08	24.90	28.16	22.57	25.77
Age group 45-54	15.12	17.55	18.29	20.96	15.36	16.16	16.11	14.55	13.75
Age group 55-64	15.24	11.19	13.56	14.19	13.85	13.56	13.83	13.84	12.02
Age group 65+	19.19	19.82	16.18	13.04	24.24	17.93	17.65	23.19	22.01
Single	58.26	59.32	54.21	57.17	64.60	55.96	61.78	62.41	58.36
Married	13.20	23.76	29.73	31.09	23.65	34.36	28.86	24.49	30.50
DivSepWid	28.53	16.93	16.07	11.74	11.75	9.68	9.36	13.10	11.14
Primary education	35.06	34.97	26.07	30.94	58.13	47.92	57.69	81.76	63.59
Middle education	59.13	34.10	49.17	41.48	29.79	36.26	34.72	11.65	17.73
Higher education	5.81	30.94	24.76	27.57	12.08	15.82	7.59	6.60	18.68
Employed	45.54	45.88	60.05	49.14	28.81	43.02	33.85	42.04	34.13
Self-employed	7.11	6.44	4.20	10.63	15.48	9.75	10.83	12.70	8.17
Unemployed	2.69	5.68	3.72	5.84	4.76	3.79	7.58	3.45	7.07
Inactive	44.65	42.00	32.03	34.40	50.96	43.44	47.74	41.81	50.63
No economic difficulties	21.76	32.89	34.31	21.48	7.07	12.37	6.98	3.67	13.25
Some economic difficulties	64.97	55.66	55.55	65.58	43.68	74.50	69.64	60.94	62.74
Frequent economic difficulties	13.28	11.45	10.14	12.94	49.26	13.13	23.38	35.39	24.01
Home owner	68.64	75.51	70.90	74.96	84.78	88.36	78.83	73.37	86.05
Dependent children	44.73	47.25	36.76	43.70	46.51	53.72	46.29	48.12	48.25
Smoker	29.17	30.36	36.89	25.50	45.65	29.78	29.07	21.21	33.34
Bad health	7.34	5.00	5.74	5.50	8.69	2.60	10.63	21.31	10.87
Fair health	19.77	21.47	16.79	28.67	15.75	15.32	28.06	32.96	20.83
Good health	72.89	73.53	77.47	65.83	75.55	82.08	61.31	45.73	68.30
Chronic problem	20.00	19.88	35.12	37.91	17.45	20.64	12.75	25.71	22.54
Part B – Means of Continuous Variables									
Income	12.785	13.789	10.024	11.715	15.264	9.765	10.453	14.723	14.852
House size	3.366	2.948	2.589	2.840	3.403	3.868	3.399	3.476	3.526
Poverty index	13.834	14.080	13.658	13.667	15.526	13.593	14.418	16.076	14.739
Social interaction	5.376	5.315	5.340	5.473	5.849	5.821	5.478	5.508	5.771
Luxury index	11.045	11.238	10.943	10.403	13.816	11.657	12.331	14.344	12.471

chronic problems. Finally in the last specification all explanatory variables are included. Due to lack of space, only the results of the second and last specification are presented here.

RESULTS

The basic results of the estimations are presented in tables III through VI, where the first two refer to the group of males and the rest of them to the female group[1]. For men, age, being married, education level and home ownership were the most significant factors affecting obesity

for almost all countries. When the smoking status was included (table III) these associations did not change but smoking appeared to be one of the most important variables limiting the probability of being obese, with the exception of Austria and Portugal. Adjusting for perceived health all the above measures maintained their level of significance with the exception of economic difficulties, which revealed significance in fewer countries than before (not shown here). Age along with SAHS dominated, as they were significant for the majority of the countries. The same picture appeared when we used chronic problems instead of health status, with the difference that these disabling conditions had no significant impact on obesity in the case of Ireland, Italy and Portugal. Finally, in the last specification (table IV) fair health lacked significance in two countries (Italy and Spain) while chronic problems in two countries (Italy and Portugal). However the results reaffirmed the fact that for men age, marriage, education, smoking, SAHS and chronic problems are the factors which either confront or promote obesity.

For the second sex group, the results confirmed that obesity is most prevalent in women. When only socioeconomic variables were used, the vast majority of the variables were important in determining obesity, except for unemployed, social interaction and existence of children. The same trend held even when the smoking status was included (table V). Smoking appeared to affect negatively all countries except Finland, Greece, Ireland and Portugal, where the smoking coefficient remained negative but lacked significance. Simultaneous consideration of smoking and health status had no effect on the significance of the other variables, making SAHS the most important variable. Its substitution by chronic conditions preserved the observed pattern once again. Finally the full model (table VI), did not change the above presented effects, and it made pretty clear that the least influential factors are unemployment, social interaction and children.

DISCUSSION

Whatever the specification of the model, age is one of the most significant factors for both sexes. Compared with the youngest age group, containing those from 16 to 29 years old, all the age groups are more prone to being obese. That result is in accordance with the previous literature (Van Lenthe *et al.*, 2000) which recorded a positive relationship between age and BMI.

Marital status is consistent for the two genders in all cases and the anticipated positive signs are documented. Researchers are not completely aware of the reasons leading to a greater BMI for the married (Rodriguez Artalejo *et al.*, 2002; Costa-Font and Gil, 2004). However, this association could be justified either by the level of stress (Linne *et al.*, 2003) or the certain family lifestyle (Bastian *et al.*, 2005). Furthermore, the family lifestyle can account for the positive relationship between obesity and existence of children for the women (Molarius *et al.*, 2000). Nevertheless, this pattern was not confirmed by our results (tables V-VI). The same rationale stands for the total number of the household members. Extended families seem to contribute to a higher body mass for females, whereas European men do not appear to be affected by household size (Costa-Font and Gil, 2004; Cantanero and Pascual, 2007).

As far as low education is concerned a positive association appears in our results for men (except Greece), as well as for women (Sundquist and Johansson, 1998; Cawley, 2000; Wardle *et al.*, 2002; Laaksonen *et al.*, 2004; Mohammad Ali and Lindström, 2005). As the level of education increases, the probability of obesity keeps falling and this trend appears in all model

Table III
Obese Men Socioeconomic Characteristics and Smoking Participation–Random Effects Probit / Marginal Effects

Variables/Countries [a]	*Austria*	*Belgium*	*Denmark*	*Finland*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*
Age group 30-44	2.248 ***	0.746 ***	-0.127	1.393 ***	0.511 **	1.308 ***	0.740 ***	0.129	0.710 ***
Age group 45-54	2.361 ***	1.236 ***	0.924 **	1.628 ***	0.891 ***	1.657 ***	1.709 ***	0.768 ***	1.098 ***
Age group 55-64	2.186 ***	1.050 ***	1.053 ***	1.975 ***	1.091 ***	1.182 ***	2.067 ***	1.188 ***	1.246 ***
Age group 65+	1.506 ***	0.888 **	1.037 ***	1.763 ***	0.880 ***	0.922 ***	1.743 ***	0.998 ***	1.279 ***
Married	0.611 ***	1.214 ***	0.642 ***	0.645 ***	1.255 ***	0.412 **	0.502 ***	1.274 ***	0.651 ***
DivSepWid	0.163	-0.546	0.948 ***	0.001	0.407	0.575	0.146	1.266 ***	0.196
Primary Education	3.122 ***	0.950 ***	0.864 ***	0.367 **	-0.084	0.353 *	0.734 ***	0.894 ***	0.412 ***
Middle Education	2.748 ***	0.681 ***	0.392 **	0.419 ***	0.070	0.319 *	0.440 **	0.397	0.188 **
Employed	-0.395 **	0.582 ***	0.227	-0.044	0.036	0.243	-0.109	-0.174	0.208 **
Self-employed	-0.065	-0.591 **	-0.421	0.296	0.382 ***	0.083	0.258 **	-0.048	0.378 ***
Unemployed	-0.409 *	1.698 ***	0.346	-0.402 *	0.111	0.301	0.188	-0.076	0.208 *
Household Size	-0.172 ***	-0.043	-0.014	-0.081	-0.019	-0.021	-0.016	0.042	0.005
Some econ. difficulties	0.085	0.109	0.202	0.147	0.029	-0.179	0.110	-0.010	-0.087
Frequent econ. difficulties	0.299 *	0.068	0.229	0.506 ***	0.075	-0.341 *	0.155	0.044	-0.123
Income	0.116	-0.233 **	-0.001	0.212 *	0.049	-0.007	-0.069	0.085	-0.052
Home Owner	-0.253 **	0.061	-0.708 ***	-0.289 **	0.043	-0.414 **	0.008	-0.217 **	-0.071
Luxury Index	-0.049 *	-0.009	-0.081 *	-0.018	-0.002	0.002	-0.005	-0.002	0.005
Poverty Index	0.019	0.036	-0.065	-0.036	0.033 *	0.032	0.034	-0.025	0.018
Social Interaction	0.045	0.034	0.224 ***	0.002	0.023	-0.006	0.012	0.037	-0.021
Smoker	-0.177	-0.318 **	-0.336 **	-0.347 ***	-0.203 ***	-0.319 ***	-0.124 *	-0.096	-0.125 **
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,170	8,419	7,467	12,171	17,642	9,068	27,794	20,704	22,872
Wald Chi^2 [b]	206.16	250.13	161.21	235.52	189.65	126.13	458.23	425.68	379.61

Notes: Calculations of the authors based on the E.C.H.P. [a] The signs ***, ** and * refer to statistical significance at the levels of 1%, 5% and 10%, respectively.
[b] The statistic is significant for all countries at the level 1%.

Table IV
Full Model for the Determinants of Obesity for Men-Random Effects Probit / Marginal Effects

Variables/Countries [a]	*Austria*	*Belgium*	*Denmark*	*Finland*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*
Age group 30-44	2.047 ***	0.809 ***	-0.171	1.291 ***	0.425 **	1.254 ***	0.738 ***	0.453 **	0.685 ***
Age group 45-54	2.091 ***	1.246 ***	0.808 ***	1.734 ***	0.729 ***	1.538 ***	1.710 ***	1.366 ***	1.050 ***
Age group 55-64	1.906 ***	1.057 ***	0.862 ***	1.634 ***	0.879 ***	1.036 ***	2.061 ***	1.491 ***	1.173 ***
Age group 65+	1.365 ***	0.813 **	0.917 ***	1.456 ***	0.602 **	0.816 **	1.738 ***	1.199 ***	1.187 ***
Married	0.763 ***	1.109 ***	0.312	0.481 **	1.336 ***	0.429 **	0.489 ***	0.645 ***	0.649 ***
DivSepWid	0.219	0.412	0.151	-0.302	0.608 *	0.610 ***	0.128	0.583 *	0.194
Primary Education	2.117 ***	0.996 ***	1.057 ***	0.143	-0.094	0.331	0.720 ***	0.954 ***	0.399 ***
Middle Education	1.794 ***	0.711 ***	0.588 ***	0.102	0.062	0.295	0.446 **	0.559 *	0.185 **
Employed	-0.371 **	0.612 ***	0.051	0.172	0.182	0.323	-0.112	-0.099	0.258 ***
Self-employed	0.026	-0.431	-0.244	0.324	0.511 ***	0.148	0.264 **	0.072 ***	0.424 ***
Unemployed	-0.433 *	1.589 ***	0.302	-0.237	0.242	0.347	0.191	-0.052	0.242 **
Household Size	-0.176 ***	-0.028	-0.181 **	-0.139 **	-0.008	-0.026	-0.016	-0.032	0.006
Some econ. difficulties	0.111	0.146	0.125	0.162	-0.005	-0.172 *	0.108	0.000	-0.090
Frequent econ. difficulties	0.310 *	0.173	0.342	0.448 **	0.017	-0.376 *	0.146	0.000	-0.137 *
Income	0.099	-0.254 **	0.428 **	0.313 **	0.046	0.028	-0.064	0.086	-0.052
Home Owner	-0.226 *	0.064	-0.885 ***	-0.264	0.045	-0.379	0.012	-0.281 **	-0.059
Luxury Index	-0.056 **	-0.024	-0.104 **	0.010	-0.006	-0.001	-0.006	-0.004	0.004
Poverty Index	-0.010	0.006	-0.105 *	-0.102 **	0.028	0.029 **	0.034	-0.047 **	0.016
Social Interaction	0.025	0.039	0.211 ***	0.071	0.042	-0.011	0.012	0.064	-0.012
Smoker	-0.185	-0.293 **	-0.205	-0.378 **	-0.207 ***	-0.315 ***	-0.122 *	-0.051	-0.115 **
Bad health	0.144	0.362 **	0.760 ***	0.754 ***	0.241	0.448 *	0.009	0.443 ***	0.112
Fair health	0.311 ***	0.518 ***	0.416 ***	0.567 ***	0.303 ***	0.376 ***	0.027	0.407 ***	0.049
Chronic problem	0.212 *	0.324 **	0.408 ***	0.317 **	0.207 *	0.029 ***	0.055	-0.088	0.233 ***
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,159	8,380	7,465	10,505	17,642	9,027	27,727	20,703	22,868
Wald Chi^2 [b]	240.22	395.73	174.82	193.45	212.92	135.72	465.66	426.26	399.79

Notes: Calculations of the authors based on the E.C.H.P. [a] The signs ***, ** and * refer to statistical significance at the levels of 1%, 5% and 10%, respectively.
[b] The statistic is significant for all countries at the level 1%.

Table V
Obese Women Socioeconomic Characteristics and Smoking Participation-Random Effects Probit / Marginal Effects

Variables/Countries [a]	*Austria*	*Belgium*	*Denmark*	*Finland*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*
Age group 30-44	1.679 ***	0.273	-0.102	1.824 ***	0.831 ***	0.369 *	0.906 ***	1.985 ***	0.745 ***
Age group 45-54	2.310 ***	1.238 ***	1.114 ***	3.153 ***	1.249 ***	0.663 **	1.749 ***	2.395 ***	1.272 ***
Age group 55-64	2.560 ***	1.350 ***	1.237 ***	3.661 ***	1.339 ***	0.521 **	2.215 ***	2.288 ***	1.701 ***
Age group 65+	2.467 ***	1.499 ***	1.053 ***	3.251 ***	1.432 ***	0.094	2.298 ***	2.227 ***	1.703 ***
Married	0.605 ***	0.863 **	0.381	-0.419 **	1.027 ***	0.939 ***	0.599 ***	1.297 ***	0.427 ***
DivSepWid	0.604 **	0.527	0.309	-0.154	0.941 ***	1.018 ***	0.666 ***	1.416 ***	0.479 ***
Primary education	1.981 ***	0.510 ***	0.801 ***	0.261 *	0.687 ***	0.449 **	1.151 ***	1.111 ***	0.832 ***
Middle education	1.623 ***	0.606 ***	0.358 **	0.494 ***	0.258 *	0.083	0.566 **	0.728 **	0.381 ***
Employed	-1.110 ***	-0.422 **	0.599 ***	-0.173	-0.235 **	-0.025	-0.505 ***	-0.171 *	-0.129
Self-employed	-0.045	-0.714 **	1.392 ***	-0.304	0.206	0.369	-0.427 **	-0.100	-0.274 **
Unemployed	-0.578 *	0.001	0.494 *	0.127	0.156	0.222	-0.182	-0.219	0.077
House size	-0.043	0.081	-0.045	0.110 *	0.021	-0.038	0.112 **	0.051	0.095 ***
Some econ. difficulties	0.364 ***	0.191	0.335 **	0.379 ***	-0.023	0.041	-0.315 **	0.045	0.121 *
Frequent econ. difficulties	0.885 ***	0.147	0.562 **	0.403 ***	-0.040	0.031	-0.298 **	0.019	0.234 ***
Income	0.161 *	-0.077	0.439 ***	0.147	0.097 *	-0.044	-0.039	0.054	-0.014
Home owner	-0.133	-0.574 ***	-0.037	-0.401 ***	-0.208 **	-0.179	-0.445 ***	-0.029	-0.060
Poverty index	-0.070 *	0.037	0.092	-0.017	0.039 **	0.072 **	0.076 ***	0.034 **	0.093 ***
Social interaction	0.071	0.015	-0.077	0.018	-0.008	0.035	-0.088 **	0.049	-0.011
Luxury index	-0.040	0.021	0.005	0.085 ***	0.042 ***	0.094 ***	0.017	0.025 *	0.035 ***
Dependent children	-0.327 *	-0.467 **	-0.120	0.055	-0.125	0.041	-0.159	0.032	-0.232 ***
Smoker	-0.299 *	-0.423 ***	-0.293 *	-0.014	-0.051	-0.238	-0.354 ***	-0.169	-0.281 ***
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,886	9,285	7,565	12,282	19,649	9,395	28,985	23,016	24,268
Wald Chi^2 [b]	355.63	242.21	136.32	337.95	277.15	139.45	553.09	513.33	716.73

Notes: Calculations of the authors based on the E.C.H.P. [a] The signs ***, ** and * refer to statistical significance at the levels of 1%, 5% and 10%, respectively.
[b] The statistic is significant for all countries at the level 1%.

Table VI
Full Model for the Determinants of Obesity for Women-Random Effects Probit / Marginal Effects

Variables/Countries [a]	*Austria*	*Belgium*	*Denmark*	*Finland*	*Greece*	*Ireland*	*Italy*	*Portugal*	*Spain*
Age group 30-44	1.498 ***	0.087	-0.359	1.037 ***	0.780 ***	0.319	0.921 ***	1.837 ***	0.697 ***
Age group 45-54	2.103 ***	0.867 ***	0.765 **	2.212 ***	1.174 ***	0.570 **	1.741 ***	2.197 ***	1.162 ***
Age group 55-64	2.235 ***	1.072 ***	0.927 ***	2.605 ***	1.190 ***	0.436 *	2.142 ***	2.075 ***	1.514 ***
Age group 65+	2.103 ***	1.247 ***	0.263	1.718 ***	1.219 ***	-0.031	2.157 ***	2.007 ***	1.458 ***
Married	0.749 **	0.806 **	0.674 **	0.241	1.005 ***	0.864 ***	0.565 ***	1.367 ***	0.442 ***
DivSepWid	0.722 **	0.704 **	0.784 **	0.428 **	0.921 ***	0.479	0.629 ***	1.479 ***	0.473 ***
Primary education	2.026 ***	0.554 ***	0.551 **	0.187	0.633 ***	0.353 *	0.971 ***	1.100 ***	0.802 ***
Middle education	1.657 ***	0.635 ***	0.249	0.591 ***	0.255 *	0.044	0.464 *	0.722 **	0.355 ***
Employed	-1.021 ***	-0.394	-0.055	-0.222 *	-0.207 *	-0.012	-0.468 ***	-0.129	-0.109
Self-employed	-0.155	-0.629	1.195 ***	0.054	0.242 *	0.527 *	-0.376 **	-0.061	-0.243 *
Unemployed	-0.503	0.068	0.012	-0.030	0.177	0.290	-0.165	-0.236	0.090
House size	-0.059	0.129 ***	0.035	0.149 **	0.043	-0.033	0.112 **	0.043	0.099 ***
Some econ. difficulties	0.375 ***	0.222 ***	0.025	0.398 ***	-0.042	-0.027	-0.291 **	0.005	0.100
Frequent econ. difficulties	0.804 ***	0.162 ***	0.192	0.605 ***	-0.093	-0.163	-0.270 *	-0.002	0.193 **
Income	0.189 **	-0.034 **	0.417 ***	0.235 *	0.087	-0.119	-0.051	0.056	-0.014
Home owner	-0.194	-0.385 ***	-0.557 ***	-0.359 **	-0.196 *	-0.044	-0.411 ***	-0.024	-0.061
Poverty index	-0.069 *	0.048 *	0.103 *	-0.056	0.031 *	0.052	0.072 ***	0.036 **	0.085 ***
Social interaction	0.083 *	0.028	-0.002	0.040	0.018	0.097	-0.078 **	0.059	0.009
Luxury index	-0.039	0.008	-0.001	-0.012	0.041 ***	0.091 ***	0.014	0.024 *	0.032 ***
Dependent children	-0.293	-0.494 **	-0.138	-0.321 *	-0.112	0.161	-0.120	0.035	-0.219 ***
Smoker	-0.390 **	-0.419 ***	-0.054	0.038	-0.020	-0.292 **	-0.315 ***	-0.228	-0.266 ***
Bad health	0.303 *	0.508 ***	0.514 *	0.564 ***	0.319 ***	0.977 ***	0.224 **	0.213 *	0.261 ***
Fair health	0.228 **	0.356 ***	0.361 **	0.469 ***	0.204 ***	0.323 **	0.245 ***	0.211 **	0.201 ***
Chronic problem	0.197	0.196 ***	0.379 ***	0.407 ***	0.257 ***	0.273 *	0.268 ***	0.045	0.281 ***
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,878	9,228	7,557	11,650	19,649	9,342	28,905	23,016	24,266
Wald Chi^2 [b]	309.78	217.06	158.86	298.17	314.57	160.12	580.11	516.73	774.84

Notes: Calculations of the authors based on the E.C.H.P. [a] The signs ***, ** and * refer to statistical significance at the levels of 1%, 5% and 10%, respectively.
[b] The statistic is significant for all countries at the level 1%.

specifications examined here. According to the literature, a higher education translates into better understanding of the benefits connected with the pursuit of a healthy lifestyle (Sobal and Stunkard, 1989; Rodriguez Artalejo *et al.*, 2002; Sarlio-Lähteenkorva *et al.*, 2004; Cantanero and Pascual, 2007).

Simultaneous examination of education and health attenuates the positive impact of low education on obesity (tables IV, VI) as compared with the case where health is not included (tables III, V). This attenuation implies a relation between the two variables. To be more concrete, if education is indicative of one's health, then a decline is anticipated in the effect exerted on the probability of being obese. Indeed, the coefficient of the educational level decreases as different measures of health, are included in the model, without losing its positive impact.

As far as the employment status is concerned, it is not possible to draw a solid conclusion for the nine European countries as a whole. Only self-employed men show a greater possibility of being obese while women employees appear less likely to be obese compared with their inactive counterparts. Possible explanations of this finding could be the more strenuous physical work for the low status employees (Wardle *et al.*, 2002) or the greater involvement of the employed individuals in sports activities (Burke *et al.*, 2001; Salmon *et al.*, 2000). Sanz-de-Galdeano (2005) produces similar results with those presented in this paper, whereas others claim that such variables are insignificant, once they use a fully adjusted model (Sarlio-Lähteenkorva *et al.*, 2004; Cantanero and Pascual, 2007). Hence a positive association between unemployment and obesity is not confirmed by this work. However, because the unemployed seek for a job, they take care of their physical appearance in order to be more attractive to prospective employers (Costa-Font and Gil, 2004). This may be the case for the Belgian and Spanish unemployed men, or for the Danish unemployed women.

Turning now to the economic indicators, it is acknowledged that the association of income with obesity is ambiguous for the case of men, whereas for women that relationship is either positive or insignificant (McLaren, 2007). Other studies, have also indicated that the prevalence of obesity is higher as we move from the higher to the lower income groups (Paeratakul *et al.*, 2002; Costa-Font and Gil, 2004; Cantanero and Pascual, 2007). However, our findings imply that income is not an important factor in determining obesity, as in most countries the above association was statistically insignificant for both sexes.

Apart from income, other indirect measures for the economic condition of the respondents were used, so as to have a more solid image of financial matters. Economic difficulties appear to be of most significance for women, since four out of the nine countries had the expected positive sign. More economic difficulties affiliate with lower income and thus a higher risk of obesity (Sarlio-Lähteenkorva and Lahelma, 1999; Laaksonen *et al.*, 2004). For men, the findings follow the above pattern in just two countries. The same rationale applies for the poverty index which is once again more significant for the female group. Furthermore, home ownership versus tenure is used as a complementary measure to income. When it is available, we should use it with income, as the former not only is an indicator of the individual's wealth but also it is constant through time (Chou *et al.*, 2004). Given the fact that home ownership means more wealth, we expect that obesity will be a more likely condition for the renters (Sarlio-Lähteenkorva and Lahelma, 1999; Wardle *et al.*, 2002; McLaren, 2007). European women confirm the negative

relation between wealth and obesity for five countries, while for men the effect is constrained to just three countries. Therefore, financial situation seems to matter the most for women rather for men.

The most prevalent divergence between males and females concerns the luxury index. For women that index increases the possibility of obesity, whereas for men it has the opposite effect. However the construction of that variable can provide an explanation for the above findings. It may be the case that labor-saving devices suggest greater wealth for men and limited household work for women (Boström and Diderichsen, 1997). Social interactions allow people to compare themselves with their co-citizens, and may contribute to a narrowed obesity prevalence (Costa-Font and Gil, 2004; Cantanero and Pascual, 2007). Nevertheless, the above findings could not be supported by our results.

Whichever specification is used in this paper, smokers appear to be less likely candidates for being classified in the obese category. This trend applies for both men and women remaining robust in the majority of the European countries; six out of nine countries for the males and five out of nine for the females. That inverse association is confirmed by the existing literature (Sundquist and Johansson, 1998; Martikainen and Marmot, 1999; Mohammad Ali and Lindström, 2005; Cantanero and Pascual, 2007). According to certain researchers this occurs because smokers have higher metabolic rates than non-smokers.

The assertion that obese people tend to adopt less healthy lifestyles is confirmed by the most straightforward results of health status. Once the model is adjusted for SAHS, it appears to be the most significant factor for the countries. Following the findings of previous studies, perceived good health was inversely related to obesity in both men and women (Martikainen and Marmot, 1999; Lahti-Koski *et al.*, 2002; Mohammad Ali and Lindström, 2005; Sanz-de-Galdeano, 2005). It is worth pointing that an incremental change in fair health led to a greater increase in the probability of obesity among women rather than among men. The same applies for the case of chronic physical or emotional conditions (except Austria and Belgium). Women are more sensitive to such problems compared to men, as a slight increase in this variable translates into a greater probability of being obese for the former (Paeratakul *et al.*, 2002; Sanz-de-Galdeano, 2005; Cantanero and Pascual, 2007). Once more, separate examination of chronic problems, makes them a factor which has explanatory power for most countries. Simultaneous consideration of the above two measures maintains the previous patterns, as both low health status and chronic problems are positively associated with obesity. Among women, these variables are significant for all countries, whereas among men for the seven of them. Finally, the fact that the marginal effects of education and economic situation attenuate, when we introduce the health variables in the model, is related to the existence of a causal relationship among them. Education and economic situation affect the health status of an individual, and vice versa.

Two forms of limitations can be acknowledged in this study. The first one is linked with the use of self-reporting measures for the calculation of the BMI variable, and thus, of obesity. Despite the fact that, respondents tend to overestimate their height (Hanson *et al.*, 1995) and overweight people to underestimate their weight (Hanson *et al.*, 1995; Sarlio-Lähteenkorva *et al.*, 2004), evidence support that when there is no available information about the actual measured

weight and height, the use of self-assessed BMI is fairly accurate. However, due to the lack of significant discrepancies between a corrected model for the case of reporting error and a model which ignores such biases, no serious degree of reporting error is anticipated in the results. The second limitation is closely related to the issue of causal relationship between some of the explanatory variables as SAHS and chronic problems, and the dependent one. The current analysis does not proceed with the correction of the possible endogeneity bias and this is due to the lack of instruments in the dataset.

CONCLUSIONS

Having as driving force the recent upheaval on the prevalence of obesity worldwide, this study aimed at investigating the socio-economic and health conditions which can interpret the phenomenon of obesity. In order to examine the above mentioned association we concentrated on nine European countries for the period from 1998 to 2001. The primary result in this paper was that the low socioeconomic status is a major determinant to the classification of an individual as obese. The findings can be summarized as following: age, marital status as well as primary education are positively related with obesity for both sexes, while the number of persons in a household and the existence of children affect mainly the behaviour of females. Obesity is less common among women employees, more spread among self-employed men, whereas no trend appears for the unemployed. Although income is a key indicator of material resources, it was found that home ownership, economic difficulties and poverty index are more strongly associated with obesity; something which was of outmost importance for women rather than for men. Moreover, existence of household devices seems to indicate greater wealth for men and limited household work for women. Finally, obese people are less likely to be smokers, but more likely to have chronic problems and perceive their general health status as bad. All the above mentioned findings appear to be more consistent for the females confirming the tendency in the literature.

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