An Empirical Investigation of Obesity Income and Education

Ozyapi, Sena

Bilkent University

15 March 2019

An Empirical Investigation of Obesity & Income and Education

Sena Ozyapi *

March 5, 2020

Abstract

Rising trends in obesity epidemic have become a serious issue for states and policymakers. Earlier studies in the medical literature have discussed the impacts of income and education levels on obesity prevalence to detect the importance of socioeconomic patterns. Recently, in the economic literature, there are studies that investigate *poverty-obesity paradox*. In this study, using a cross-sectional data set covering 31 countries from Eurostat for 2014, we estimate the effects of income and education levels on obesity prevalence among different age groups and countries of origin. Our results show that increasing education and income have a significant and negative influence on obesity prevalence. In addition, we found that obesity is less likely to occur in countries with higher social welfare spending.

JEL codes: *C13, Estimation: General; C51, Model Construction and Estimation; I14, Health and Inequality.*

Keywords: *Obesity; Body Mass Index; Income; Education*

*The paper was written during the academic internship of the author at Bilkent University under the supervision of Prof. H. Cagri Saglam and Dr. Eray Yucel. The author is grateful for their invaluable contributions.

1 Introduction

As one of the major problems of the industrial era, obesity is a challenge (Erixon, 2016) that leads serious problems not only for individuals but also for society in different levels. Although, studies into the causes and consequences of obesity are popular in the health sector, in recent years the visible damage of obesity to society has become a serious problem for many states and policymakers. Hence, researches had begun to focus on the socioeconomic causes of obesity. There are several studies on the causes of the imbalance between energy intake and energy expenditure. While some studies emphasize technological advances (Lakdawalla & Phillipson, 2002) that reduced energy expenditure by making people have a sedentary life, others dwell on the role of low priced (Finkelstein et al., 2014; Drewnowski & Darmon, 2005) foods with high-calorie density (Drenowski & Specter, 2004) an increase in energy intake. In particular, some argue that changing food preferences with socioeconomic status influence diet quality and weight gain (Turrell et al., 2002). Then, it has become reasonable to think that the impacts of principal differences in social groups such as income and education (Drenowski & Specter, 2004) play a crucial role in obesity occurrence. In other words, consumer choices can be taken into account in a socioeconomic context to detect the decisive influence of income and education level on obesity prevalence. Hence, the main concern might be the potential threat of obesity for the society which is the increasing gap between the obesity prevalence rates in different socioeconomic groups.

Numerous studies conclude that the impact of income and education on obesity is significant, although they have some distinct perspectives. In the first place, Lakdawalla & Phillipson (2002) argue that rising obesity rates stem from the technological change in the widest sense. Their claim is new living standards that come with the sedentary lifestyle have created a problem for the level of energy expenditure. On the other hand, with the new methods introduced in agriculture, foods have become cheaper and as a result, total calorie intake has increased. The results, however, present that obesity occurrence change with the income level because of the altering patterns in food choices and desires to an ideal body. Likewise, other researches point out the variation on food prices that were shaped the diet quality of people. Drenowski et al. (2004, 2005) and Finkelstein et al. (2014) emphasize the trends in the existing food industry that is based on producing low-cost foods that have large calorie density. The focal point in their argument is that lower income groups could only afford to low price foods filled with excess calories that lower the diet quality. Moreover, Pikhart et al. (2007) contribute to the literature by introducing the inverse effect of education on obesity.

The novelty of this paper is that it analyzes the data sets from a perspective that is not previously considered. Especially, our empirical methodology on 2014 Eurostat data have not yet been used in the previous economic literature in terms of its analysis of income and education effect on obesity prevalence. In addition, our data sets are comprehensive not only in terms of the number of European countries involved in data sets, but also in terms of demographic information such as age, gender, income and education levels.

In the remainder of the paper, Section 2 provides a review of the earlier literature, while Section 3 is dedicated to our empirical analysis. We define the data in subsection 3.1 and the model in 3.2. Then, in 3.3, we present our main findings under different subheadings. Lastly, in section 4, we conclude the study with a final discussion.

2 Review of the Literature

In general, studies that have taken the obesity as a subject in the socioeconomic context argue that association between income and obesity is significant. In the first place, Pickett et al. (2005)[1] refer to the correlation between obesity and income inequality. They assert that low-income people tend to have unhealthy habits because cheap and high-calorie foods are more accessible and the environment they live in requires less physical activity. Likewise, Zhang et al. (2004)[2] studied on obesity among American adults using data from the National Health and Nutrition Examination Survey. They found out that there is a significant inverse relation between socioeconomic status and obesity among women compared to men. Salmasi and Celidoni (2017)[3] examine the effect of poverty on the probability of being obese in Europe. Their main findings demonstrate that poverty is positively linked with the prevalence of obesity and poor individuals are more likely to be obese than non-poor individuals.

There are other studies addressing the effect of income level on consumer preferences that are highly related to diet quality and weight gain. Turrell et al. (2002)[4] highlight the remarkable association between socioeconomic backgrounds and food choice. Individuals from socioeconomically disadvantaged backgrounds were less likely to consume grocery foods which are high in fiber and low in fat and sugar. Moreover, according to their results, low income groups consume less variety of fruits and vegetables compared to higher income groups.

As another determinant of socioeconomic status, the education level is also associated with obesity. Monteiro et al. (2001)[5] investigated the relation in Brazil and found that education had a different effect on obesity among men and women from different income groups. For men, education has no impact on obesity in lower income groups while better education has negative impact for people with higher income. On the other hand, for women, regardless of which income group they are, education has a much more significant impact on the development of obesity than men. From three samples of Central and Eastern European populations, Pikhart et al. (2007)[6] affirmed that education is inversely related to the prevalence of obesity. Furthermore, they highlighted that the inverse linkage between socioeconomic position and prevalence of obesity is more likely to occur in western countries. In addition, Lamerz et al. (2005)[7] considered parental education which they found that it is strongly associated with obesity occurrence where they show a strong relationship that children of less educated parents have more risk to be obese than others. In the same way, based on 16 European countries cross-sectional survey from 2010, Gallus et al. (2015)[8] share their results that prevalence of obesity significantly decreased with education level. Country specific studies also yield similar results. In Germany, according to Schienkiewitz et al. (2017)[9] obesity occurrence is widespread among people who have low education and also the effect of education is stronger for women than men. In Portugal, Alves et al. (2017)[10] found that while lower educational levels had no impact on obesity prevalence for men, it has a significant positive impact on obesity occurrence among women.

A similar gender asymmetry is also detected for income by Ogden et al. (2017)[11] in the United States. Their observations on the prevalence of obesity among adults point out that education and income make a difference among women, but for men this is only valid for education. Furthermore, the influence of income and education is not consistent since it varies with ethnic origin of individuals.

The role of food prices on the obesity epidemic has also been considered by various studies. Sturm and Datar (2007)[12] examined the link between food prices and related changes in the Body Mass Index (BMI) among elementary school children in the USA. They found that vegetables and fruits with lower prices had significantly lowered the weight gain, especially for children in poverty. Meantime, Powell (2009)[13] examined the changes in BMI of adolescents by looking at the fast food prices. She reports that fast food prices have a significant effect on BMI of young individuals, especially who are from low-middle socioeconomic status. Drewnowski and Darmon (2005)[14] emphasize that the cheapest foods are the ones filled with refined grains, added sugars and added fats. Hence, people like to consume those processed foods compared healthier ones such as fish,vegetables and fruits which are relatively more expensive. Likewise, in another study, Drewnowski and Specter(2005)[15] associated lower-quality diets with poverty and food insecurity. Finkelstein et al. (2014)[16] investigates the changes in food or beverage price to understand whether there is a relation between food prices and BMI among U.S. consumers. Although they found a little evidence of the relation between prices and weight gain, their research suggest that lowering the prices of healthy foods may play a crucial role in reducing obesity rates.

Finally, Lakdawalla and Phillipson (2002)[17] underline the influence of technological advances on food prices, consumption patterns and weights. They argue that, as a result of the increase in consumption of food and decrease in daily physical activity, obesity epidemic spread out between 1976 to 1994. They estimated that nearly forty percent of the increase in obesity is due to lower food prices and sixty percent is due to the reduction of physical activity.

All in all, although the socioeconomic reasons for obesity are widely studied in the medical literature, studies in the economic literature that discuss the impact of poverty on obesity prevalence are not addressed broadly . In addition, a cross-sectional study that investigates the relationship between obesity prevalence, income and education level in Europe from 2014 statistics has not been discussed in detail in earlier literature.

3 Empirical Analysis

3.1 Data

In this study, we used two cross-sectional data sets for 2014 taken from Eurostat[18] covering the proportion of specified groups of people in 31 European countries in the five different Body Mass Index (BMI) categories. In the first data set, groups were specified by the income level, gender and age of people while they were specified by education level, gender and age in the second data set. Income levels are categorized by quintiles while education levels divide in three different categories by using International Standard Classification of Education. The data set containing the income quintiles comprise of 56,700 observations, and the data set containing the education level comprises of 38,400 observations.

Body Mass Index (BMI) is a simple index that is commonly used to classify underweight, overweight and obesity in adults. BMI is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2) (WHO, 1995). Then, BMI categories are defined by specific ranges of BMI to identify the weight status of individuals. Particularly, individuals are defined as obese if their BMI is greater than 30, overweight if their BMI is greater than 25, normal weight if their BMI is between 18.5 and 25 and underweight if their BMI is less than 18.5. In the data sets, there is an additional group for people whose BMI is between 25 and 30 in order to distinguish obese and overweight individuals.

The data sets were structured to identify groups with an identifier key containing all demographic information and to show what percentage of these groups were in the BMI category. We have decomposed each information such as income level, age, gender in the descriptive key, and we have created separate categories for them. Thus, we have made it appropriate to estimate each demographic feature.

3.2 Model Specification

We measure the fraction of people in a certain BMI group using P^i where P is the proportion of people in a specified BMI category and i indicates the index of the corresponding BMI category. We use $i = 1$ for obese group which is BMI ≥ 30, $i = 2$ for overweight group, $i = 3$ for group that is overweight but not obese, $i = 4$ for normal weight and finally $i = 5$ for underweight group.

It should be noted that due to our data structure, P^i is not regressed in a regular fashion which is driven by linear variables but regression is entirely controlled by various dummy variables.

The model that we estimated the impact of income constructed as in Equation 1:

$$P_j^i = \alpha_0 + \alpha_1 Female_j + \sum_{l=1}^{4} \beta_l Q_{l,j} + \sum_{k=1}^{7} \eta_k A_{k,j} + \sum_{t=1}^{32} \gamma_t C_{t,j} + \epsilon_j \tag{1}$$

In Equation 1, dummy variable Q_l represents the income quintile where $l = 1, .., 4$ indicates the corresponding income quintile. Following, A_k represents the age group for $k = 1, .., 7$ and C_t represents the individuals country of origin for $t = 1, .., 32$. Since the data only consist of qualitative variables, we select the following classes as reference groups; third quantile for income, male for gender, year 45-54 for age and Germany for countries.

Furthermore, by grouping countries with specific characterizations (social democratic states, countries with high/low social expenditures per capita etc.) , we estimated whether those characteristics have an impact on BMI or not by using Equation 2:

$$P_j^i = \alpha_0 + \alpha_1 Female_j + \sum_{l=1}^{4} \beta_l Q_{l,j} + \sum_{k=1}^{7} \eta_k A_{k,j} + \epsilon_j + \sum_{\mathrm{n}=1}^{6} \delta_{\mathrm{n}} \mathrm{D}_{\mathrm{n,j}} \tag{2}$$

In Equation 2 the additional dummy variable $D_{n,j}$ represents the country's characteristics where $n = 1, .., 6$ indicates whether it is a social democratic state or a Nordic country etc.

Finally, for the second data set, to measure the effect of education level on BMI we applied the same model specification in Equation 1 only by replacing education level with income quintile as it is shown in Equation 3:

$$P_j^i = \alpha_0 + \alpha_1 Female_j + \sum_{r=1}^{2} \phi_r E_{r,j} + \sum_{k=1}^{7} \eta_k A_{k,j} + \epsilon_j \tag{3}$$

In Equation 3 E_r represents the category of education and $r = 1, 2$ indicates the individuals' level of education. This time we select the secondary level of education as a reference group and kept the others same.

3.3 Main Findings

3.3.1 Effects of Income on BMI

The estimates for BMI group ≥ 30 in the Table 1 demonstrate that the prevalence of obesity is at least 1.5 percent more likely for people who are in the first and second quintile income groups while it is around 3 percent less likely for people from the highest income level. However, there is not enough evidence to say that the fourth quintile is less likely to be obese then the third quintile. These results are similar to the findings of Salmasi and Celidoni (2017) and Pickett (2015), which emphasize the role of income level in obesity prevalence.

There is no gender asymmetry, especially on obesity prevalence differing fro the conclusion of Ogden et al . (2017) who find that impact of income level for women was more decisive than men. In addition, we found another demographic determinant that older age groups - up to 75 years - were more likely to be obese.

Estimations for other BMI categories (overweight, normal, underweight) demonstrate consistent results in Table 1 but with weaker evidence for income and age effect as we move from the estimation of overweight groups to underweight groups. In other words, the number of significant explanatory variables decrease as we move from highest BMI category to lowest one. Nevertheless, as it can be seen from Table 1, regression results for other BMI groups indicate that people from the fifth income quintile 4.31 percent less likely to be overweighted and 4 percent more likely to be normal weighted compared to other income groups. Moreover, one main difference for all those BMI groups compared to the obese group is gender effect. There is strong evidence that males tend to be overweight while females are more likely to be normal or underweight.

3.3.2 Effects of Education on BMI

In the second model, as displayed in Table 2, we estimated the effect of education and found that the increase in the level of education has a negative influence on obesity prevalence. While the probability of obesity occurrence is 3.30 percent more likely for least educated people, it is 4.30 percent less for the highest educated ones. Identically, the probability of being overweight is 8.05 percent less likely for the ones who have the highest education level and lower educated people tend to be 2 percent more overweight than people who are better educated. In general, as Monteiro et al. (2001), Pikhart et al. (2007) and Gallus et al. (2015) have previously noted, the level of education is estimated to be an important socioeconomic feature affecting the prevalence of obesity in society.

3.3.3 Observations on Country Characteristics

Finally, we have expanded our analysis by looking at the impact of specific country characteristics on the obesity prevalence. As Table 3 indicates, the prevalence of obesity tend to be less for people who live in countries that are developed, socially democratic and which have the highest social expenditure per capita. In particular, obesity is 2.60 percent less likely to occur among socially democratic states compared to other countries. We included Nordic countries[19] as a specific group in our analysis. Since as a remarkable part of Europe, Nordic countries share a common territory with a common historical and cultural identity. In particular, their Nordic model of social welfare is our interest to study whether it has a significant impact on their societies obesity prevalence rates. In our analysis, we found that obesity prevalence 2.28 percent less for people from Nordic countries compared to others. On the other hand, we grouped countries in terms of their rate of social expenditure per capita (OECD, 2014). Then, the results show that obesity prevalence is 2.80 percent less likely for people who live in the countries with highest social expenditure per capita, while it is 3.56 percent more likely for people who live in countries that have the lowest social expenditure per capita. In the previous literature, the impact of such country characteristics on the prevalence of obesity has not been discussed before.

3.3.4 Robustness

We performed the robustness analysis of our model, which is estimated above with OLS, using Count Models. Since count models require integer values for the dependent variable we were re-scaled the population proportions by multiplying them by 100. Then we re-estimated the model by using *Poisson* and *Exponential* methods with *quasi-maximum likelihood (QML)* estimator. Poisson and Exponential methods with QMLE are consistent even the conditional distribution of the dependent variable is not Poisson or exponential because it is sufficient that the conditional mean is correctly specified (Wooldridge, 1997). The new results showed no remarkable differences from OLS estimates. The direction of effects stays the same while significance for variables tend to increase for the Poisson and not differ at all for the exponential. Overall, it can be said that our initial estimates are robust up to changes in estimation technique, i.e. count model and alternative underlying methods Poisson And Exponential QMLE. Still, for the sake of convenience, the paper keeps the OLS estimates.[20]

4 Concluding Remarks

Modern society is facing a growing set of problems due to increasing rates of obesity prevalence. In recent years, it has been argued that there is an association between increased obesity rates and socioeconomic dynamics that determine social status. As the main factors determining social status, the share of income and education level of individuals in this association has been under investigation. From this point of view, we examined how the prevalence of obesity varies between income and education levels among society.

Our findings revealed that obesity occurrence is negatively related to increases in income and education levels of individuals. In addition, while older people are more likely to be obese, there is no gender asymmetry in obesity formation. Furthermore, our analysis demonstrated that obesity is less likely to occur among people who live in a social democratic state or a country with higher social expenditure per capita. In this context, it can be said that the political characteristics of the countries regarding social welfare are at least as important as the individual level social characteristics.

The novelty in this paper is that the data sets we have used have not been analyzed in the previous literature in terms of our perspective. In addition to this, our findings revealed the relationship using the information of more than 31 countries in the Europe. Hence, it can be said that we have more general conclusions about the relationship between obesity and social status determinants, since the scope of the study is broad in terms of the number of countries included in the estimation.

Overall, based on the results presented, one can suggest different policies. While individual-level policy efforts to prevent obesity epidemic may be more effective by focusing on low-income and less educated groups, it may be more beneficial for states to work to increase social welfare for the whole population.[21]

Notes

[1]Pickett et al. (2005) uses data on income inequality obtained from the UNDP Human Development Indicators in 2003, data on the proportion of the population who are obese obtained from the International Obesity TaskForce in 2002 and calorie intake per capita per day from the OECD Health database in 2003. The data sets were studied on 21 eligible countries; Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the UK, and the USA.

[2] Zhang et al. (2004) uses a data from the U.S. based National Health and Nutrition Examination Survey III conducted between 1988 and 1994 to assess the degree of inequality in the distribution of obesity across U.S population.

[3] Salmasi and Celidoni (2017) investigate link between poverty and obesity in Europe by analyzing data drawn from the Survey of Health, Ageing and Retirement (SHARE) and the English Longitudinal Study of Ageing (ELSA)

[4]Turrell et al. (2002) used data from their own survey in Australia in 2000 with 1003 individuals.

[5] Monteiro et al. (2001) uses data obtained from a World Bank Living Standard Measurement Survey undertaken in Brazil from March 1996 to March 1997 (IBGE 1998).

[6]Pikhart et al. (2007) uses data come from the Health, Alcohol and Psychosocial factors in Eastern Europe (HAPIEE) study based on urban samples in Russia, Poland and the Czech Republic collected in 2002–2005

[7]Lamerz et al. (2005) uses a data from their own survey in Aachen/Germany for the 2002/2003 school year and who were born between 1 July 1995 and 30 June 1996

[8]Gallus et al. (2015) use data from a pan-European survey provided by DOXA in 2010 with 16

countries over 16000 individuals.

[9]Schienkiewitz et al. (2017) used a self-reported data from German Health Update study series

[10]Alves et al. (2017) obtained their data the forth Portuguese Health Survey in 2006

[11]Ogden et al. (2017) Prevalence of obesity among adults, by household income and education US 2011-2014 (National Health and examination Survey)

[12]Sturm and Data (2007) have taken the data from the Early Childhood Longitudinal Study Kindergarten Class (ECLS-K) in USA from 1998–1999, merged with data on food prices from the American Chambers of Commerce Researchers Association (ACCRA).

[13]Powell (2009) combined individual-level panel data from the 1997 National Longitudinal Survey of Youth on adolescents with external data on fast food prices and general food prices obtained from the American Chamber of Commerce Researchers Association (ACCRA).

[14] Drewnowski and Darmon (2005) use the data of change in food prices from Economic Research Service of the USDA, FoodReview in 2002 and The Healthy People 2010 report to detect the relationship between income and obesity.

[15]Drewnowski and Specter (2004) use data for 68 556 US adults in the National Health Interview Survey from 1988 to 1994.

[16]Finkelstein et al. (2014) use results of earlier studies.

[17] Lakdawalla and Phillipson (2002) uses individual-level data from the US National Health Interview Survey (NHIS), the National Health and Nutrition Examination Survey (NHANES) from 1988 to 1994, and the National Longitudinal Survey of Youth (NLSY).

[18]Accessible at *https://ec.europa.eu/eurostat/statistics-explained/index.php/Overweight_and_obesity_-_BMI_statistics* following the menu items and search tabs.

[19] We include Denmark, Finland Norway, Sweden to Nordic group

[20]Those results are available from the author upon request.

[21]Further research may include the Human Development Index (HDI) to detect the effect of development level for country characteristics. In addition, change in food prices for countries could be analyzed in order to investigate the influence of food prices on obesity prevalence.

References

Alves, Luis., Stringhini, Silvia., Barros, Henrique., Azevedo Ana., Marques-Vidal, Pedro. (2017) "Inequalities in obesity in Portugal: regional and gender differences", *The European Journal of Public Health* 27(4):775-780

Drewnowski, A., Darmon, N. (2005) "The economics of obesity: dietary energy density and energy cost." *The American Journal of Clinical Nutrition* 82(1):265S–273S

Drewnowski, Adam., Specter, SE. (2004) ”Poverty and obesity: the role of energy density and energy costs” *The American Journal of Clinical Nutrition* 79(1):6–16

Erixon, Fredrik. (2016) ”Europes Obesity Challenge”, *ECIPE Policy Brief, No. 7*

Finkelstein, Eric A., Strombotne, Kiersten L., Zhen, Chen., Epstein, Leonard H. (2014) ”Food Prices and Obesity: A Review Advances in Nutrition” 5(6):818–821

Gallus, Silvano., Lugo, Alessandra., Murusic, Bojana., Bosetti, Cristina., Boffetta, Paolo., Vecchia, Carlo La. (2015) ”Overweight and Obesity in 16 European Countries”, *European Journal of Nutirition* 54:679-689

Lakdawalla, Darius & Philipson, Tomas, (2009) ”The growth of obesity and technological change”, *Economics and Human Biology* 7(3):283-293

Lamerz, A., Kuepper-Nybelen, J., Wehle, C., Bruning, N., Trost-Brinkhues, G., Brenner, H., Hebebrand, J., & Herpertz-Dahlmann, B. (2005) ”Social class, parental education, and obesity prevalence in a study of six-year-old children in Germany”, *International Journal of Obesity* 29:373–380

Monteiro, Carlos A., Conde, Wolney L., Popkin, Barry M. (2001) ”Independent Effects of Income and Education on the Risk of Obesity in the Brazilian Adult Population”, *The Journal of Nutrition* 131(3):881–886

Pickett, Kate E, Shona, Kelly, Brunner Eric, Lobstein, Tim, Wilkinson, Richard G. (2005) “Wider income gaps, wider waistbands? An ecological study of obesity and income inequality”, *Journal of Epidemiol Community Health* 59:670–674.

Pikhart, Hynek., Bobak, Martin., Malyutina, Sofi a., Pajak, Andrzej., Kubínová, Růžena., Marmot, Michael. (2007) ”Obesity and Education in Three Countries of the Central and Eastern Europe: The HAPIEE Study”, *Central European Journal of Public Health* 15(4):140–142

Powell, Lisa M. (2009) "Fast food costs and adolescent body mass index: Evidence from panel data", *Journal of Health Economics* 28(5):963-970

OECD. (2014) *OECD Social Expenditure* (database), https://doi.org/10.1787/socx-data-en (accessed on 09 February 2019)

Ogden, Cynthia L., Fakhouri, Tala H., Carroll, Margaret D., Hales, Craig M., Fryar, Cherly D., Lİ, Xianfen., Freedman, David S. (2017) "Prevalence of Obesity Among Adults, by Household Income and Education-United States, 2011-2014", *Morbidity and Mortality weekly report* 66(50)

Salmasi, Luca., Celidoni, Martina. (2017) "Investigating the poverty-obesity paradox in Europe", *Economics & Human Biology* 26:70-85

Schienkiewitz, Anja., Mensink, Gert B.M., Kuhnert, Robert., Lange, Cornelia. (2017) "Overweight and obesity among adults in Germany", *Journal of Health Monitoring* 2(2):20-27

Sturm, R., Datar, A. (2005) "Body mass index in elementary school children, metropolitan area food prices and food outlet density", *Public Health* 119(12):1059-1068

Turrell, G., Hewitt, B., Patterson, C., Oldenburg, B., Gould, T.(2002) "Socioeconomic differences in food purchasing behavior and suggested implications for diet-related health promotion", *Journal of Human Nutrition and Dietetics* 15(5):355-364

WHO. (1995) Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report Series 854. Geneva: World Health Organization.

Wooldridge, Jeffrey M. (1997). "Quasi-Likelihood Methods for Count Data," Chapter 8 in M. Hashem Pesaran and P. Schmidt (eds.) Handbook of Applied Econometrics, Volume 2, Malden, MA: Blackwell, 352–406.

Zhang, Qi, Wang, Youfa. (2004) "Socioeconomic inequality of obesity in the United States: do gender, age, and ethnicity matter?", *Social Science & Medicine* 58(6):1171-1180

Tables and Figures

	Income				
Variable	GE30	GE25	GE2529	GE18524	GE185
C	20.89744	66.38430	45.48678	34.40180	-0.58301
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.15930)
QU1	1.784293	-0.318997	-2.100275	0.376783	0.315427
	(0.00000)	(0.57830)	(0.00000)	(0.54470)	(0.12360)
QU2	1.557303	1.016551	-0.543879	-0.814725	0.217828
	(0.00000)	(0.07700)	(0.23390)	(0.19090)	(0.28810)
QU4	-0.668746	-0.587113	0.081875	0.604169	-0.050163
	(0.07630)	(0.30880)	(0.85830)	(0.33390)	(0.80750)
QU5	-2.97780	-4.31262	-1.33764	4.03935	0.18025
	(0.00000)	(0.00000)	(0.00440)	(0.00000)	(0.39170)
F	-0.07353	-12.37281	-12.29981	9.57377	2.77486
	(0.75920)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y1519	-17.66989	-46.19749	-28.52904	32.33866	11.35884
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y2024	-14.98562	-35.15037	-20.16831	30.36287	4.75502
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y2534	-10.26647	-21.34380	-11.07609	19.06908	2.29969
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y3544	-4.73049	-9.01291	-4.27731	8.26536	0.77477
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00210)
Y5564	3.32406	5.66291	2.34214	-5.65032	-0.04146
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.86910)
Y6574	2.51682	7.02728	4.51469	-6.85386	-0.17033
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.50110)
YGE75	-3.16584	-0.70529	2.45884	0.06980	0.54673
	(0.00000)	(0.33950)	(0.00000)	(0.93050)	(0.03810)
BE	-2.31224	-2.34421	-0.03468	1.07440	1.24386
	(0.01120)	(0.09260)	(0.97500)	(0.47700)	(0.01240)
BG	-2.77103	0.41722	3.17964	-0.57242	0.09192
	(0.00280)	(0.76860)	(0.00480)	(0.70960)	(0.85580)
CZ	1.545815	4.182581	2.630276	-3.332938	-1.053351
	(0.10070)	(0.00370)	(0.02170)	(0.03280)	(0.04050)
DK	-2.40509	-4.44294	-2.04360	4.19863	0.08740
	(0.01320)	(0.00280)	(0.08320)	(0.00910)	(0.86890)
EE	2.95931	2.68946	-0.27053	-2.87716	0.10124
	(0.00170)	(0.06190)	(0.81320)	(0.06530)	(0.84380)

IE	0.08898	2.10951	2.00774	-2.46981	0.04801
	(0.92770)	(0.15970)	(0.09240)	(0.12880)	(0.92850)
EL	-0.12289	4.36110	4.48494	-4.00972	-0.47652
	(0.89460)	(0.00210)	(0.00010)	(0.00910)	(0.34640)
ES	0.25625	2.24000	1.98875	-2.35750	0.11375
	(0.77720)	(0.10580)	(0.07100)	(0.11640)	(0.81790)
FR	-1.07125	-3.84750	-2.78500	1.80250	2.04625
	(0.23680)	(0.00550)	(0.01150)	(0.22990)	(0.00000)
HR	1.97242	5.44762	3.47739	-5.41206	-0.18486
	(0.03710)	(0.00020)	(0.00250)	(0.00060)	(0.72010)
IT	-5.78625	-6.97000	-1.18875	5.24875	1.72125
	(0.00000)	(0.00000)	(0.28030)	(0.00050)	(0.00050)
CY	-0.85843	0.10088	0.96821	-1.20273	1.08016
	(0.34940)	(0.94270)	(0.38540)	(0.42900)	(0.03100)
LV	2.40546	3.12787	0.71265	-2.59200	-0.66789
	(0.00930)	(0.02690)	(0.52590)	(0.09070)	(0.18540)
LT	-0.44685	2.72512	3.17309	-2.42851	-0.28580
	(0.62620)	(0.05220)	(0.00450)	(0.11040)	(0.56810)
LU	-1.04238	-3.14074	-2.09408	1.96607	0.93061
	(0.29980)	(0.04110)	(0.08680)	(0.23810)	(0.08990)
HU	3.624796	3.127692	-0.490819	-4.428261	1.298241
	(0.00010)	(0.02490)	(0.65780)	(0.00340)	(0.00910)
MT	8.21415	8.70388	0.48093	-8.15886	-0.62172
	(0.00000)	(0.00000)	(0.68760)	(0.00000)	(0.24680)
NL	-3.01750	-2.42750	0.58500	2.64625	-0.22000
	(0.00090)	(0.07970)	(0.59520)	(0.07800)	(0.65620)
AT	-1.97625	-2.65568	-0.68709	2.64119	-0.00974
	(0.02970)	(0.05600)	(0.53390)	(0.07950)	(0.98430)
PL	0.51500	3.23750	2.72625	-3.86625	0.62625
	(0.56950)	(0.01950)	(0.01330)	(0.01010)	(0.20510)
PT	-0.69125	1.34125	2.03125	-1.78875	0.45625
	(0.44520)	(0.33280)	(0.06510)	(0.23340)	(0.35590)
RO	-6.90625	2.79000	9.69875	-1.55750	-1.23250
	(0.00000)	(0.04400)	(0.00000)	(0.29950)	(0.01270)
SI	1.61203	3.64678	2.03593	-2.82367	-0.87492
	(0.08110)	(0.00990)	(0.07000)	(0.06530)	(0.08270)
SK	0.19668	4.01639	3.81942	-4.04203	-0.09102
	(0.83200)	(0.00470)	(0.00070)	(0.00860)	(0.85720)
FI	0.41543	1.95849	1.54240	-1.77683	-0.32199
	(0.65910)	(0.17390)	(0.17800)	(0.25500)	(0.53090)
SE	-3.07234	-3.48790	-0.40830	-4.07738	-1.40202
	(0.00120)	(0.01630)	(0.72340)	(0.00960)	(0.00680)
UK	2.57671	2.62992	0.05299	-3.02407	0.40327

	(0.00490)	(0.06010)	(0.96200)	(0.04610)	(0.41900)
IS	1.88261	6.39902	4.52016	-4.95383	-1.43658
	(0.04170)	(0.00000)	(0.00010)	(0.00120)	(0.00440)
NO	-3.45213	-1.39410	2.05021	1.97943	-0.58509
	(0.00020)	(0.31720)	(0.06440)	(0.19020)	(0.23950)
TR	5.23000	6.53750	1.31125	-7.59125	1.04625
	(0.00000)	(0.00000)	(0.23370)	(0.00000)	(0.03430)

Table 1: Obesity and Income quintiles

Education					
Variable	GE30	GE25	GE2529	GE18524	GE185
C	20.22519	67.56456	47.34351	35.54155	-0.28777
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.28700)
ED02	3.30509	2.85681	-0.44737	-2.84499	0.73456
	(0.00000)	(0.00000)	(0.31420)	(0.00220)	(0.00030)
ED58	-4.27996	-8.04664	-3.76822	-0.21855	-0.52535
	(0.00010)	(0.00000)	(0.00000)	(0.81370)	(0.00980)
F	0.14342	-12.01701	-12.16383	9.31883	2.60764
	(0.11320)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y1519	-17.84901	-48.44356	-30.59561	15.62509	7.40720
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y2024	-13.99071	-34.50916	-20.52323	29.52926	4.91014
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y2534	-8.62629	-19.09262	-10.47080	16.95756	2.19361
	(0.85370)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Y3544	-3.63357	-7.59147	-3.95903	6.78953	0.75187
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.02050)
Y5564	3.00750	4.94806	1.94319	-4.87502	-0.14993
	(0.00000)	(0.00000)	(0.00620)	(0.00100)	(0.64320)
Y6574	1.86722	6.36753	4.49260	-6.30052	-0.15918
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.62380)
YGE75	-4.12202	-2.67013	1.45240	1.72022	0.62025
	(0.00000)	(0.00530)	(0.04350)	(0.25150)	(0.05900)

Table 2: Obesity and Education

Countries					
Variable	GE30	GE25	GE2529	GE18524	GE185
DEV2	-1.41617	-2.89776	-1.48335	2.49759	-0.31188
	(0.00000)	(0.00000)	(0.0000)	(0.00000)	(0.02530)
NORDIC	-2.28794	-3.46495	-1.17775	2.00498	-0.73381
	(0.00000)	(0.00000)	(0.01240)	(0.00170)	(0.00040)
SOCDEM	-2.60680	-3.78553	-1.18034	2.77192	-0.67264
	(0.00000)	(0.00000)	(0.00530)	(0.00000)	(0.00030)
HSOCEXP	-2.10471	-4.72863	-2.62608	3.57718	0.22309
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.13650)
LSOCEXP	3.56713	3.34465	-0.22219	-3.13886	0.08018
	(0.00000)	(0.00000)	(0.56740)	(0.00000)	(0.63910)

Table 3: Obesity in Selected Country Groups