The determinants of body mass in Greece: Evidence from the National Health Survey

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Abstract

In this study we explore the determinants of body-weight in Greece utilizing information at the individual level from the National Health Survey of 2009. BMI has been treated as both, a cardinal and an ordinal measure of body-weight, while different estimation techniques were applied (OLS, ordered probit and unconditional quantile regression). In our attempt to identify the major determinants of BMI outcomes in Greece we employed a wide range of demographic, socio-economic, lifestyle, health-related and regional characteristics. The unconditional quantile estimates uncovered differences in the estimated impact of several correlates across the BMI distribution, highlighting their superiority vis-a-vis the simple mean-based linear models of BMI. Examining the entire BMI distribution and targeting specific segments of the Greek population can render public health policies against obesity more efficient and prolific.

Keywords: Body mass index, obesity, ordered probit, unconditional quantile regression, Greece.
JEL classifications: I10, I12, C21

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I. Introduction

The problems of excess body weight in general and obesity in particular are becoming more acute worldwide and the investigation of the factors determining body weight holds center stage among pertinent researchers and the general public (Grossman and Mocan, 2011).In the present study we attempt to identify the determinants of the Body Mass Index (BMI)[1] utilizing cross-sectional data from the most recent Greek National Health Survey (GNHS), administered in 2009. Greece is a Mediterranean country experiencing serious body weight problems and facing increased rates of obesity prevalence. Recent relevant studies concerning other European countries point out that the observed soaring overweight prevalence rates are associated with significant cross-country variations (Sanz-de-Galdeano, 2005; Michaud et al., 2006; Knai et al., 2007). For instance, data from the European Health Interview Survey 2008 indicate that from a set of 18 European countries, Greece is ranked 5th with respect to the prevalence of overweight and 6th when obesity prevalence is considered. These figures confirm earlier evidence for Greece regarding the obesity problem of its population (Sanz-de-Galdeano, 2005 and Michaud et al., 2006). Although the causes of excess body weight are undoubtedly complex, the “obesity epidemic” is not simply a problem of genetics but also the accumulated effect of human behavior (Philipson, 2001; Cawley, 2004a; Lakdawalla and Phillipson, 2009). In addition, excessive body weight is associated with a plethora of harmful health consequences; the pertinent findings of the related human biology literature are irrefutable. From this perspective, the public health debate on the harmful effects of excess weight (Mokdad et al., 2003 ; Whitlock et al., 2009) and on the

[1] BMI is defined as ratio of weight in kilograms to the square of height in meters (WHO, 2000). This indicator is used widely in social sciences although it does not constitute an ideal approximation of individual fatness (Bukhauser and Calwey, 2008).

significant cost that overweight people impose on the society through the health-care systems (Fry and Finely, 2005; Finkelstein et al., 2009) is booming.

A large body of empirical research in health economics adopts a standard utility maximization framework to identify and analyze the determinants of body weight outcomes at the individual level (Cawley, 2004a; Lakdawalla and Phillipson, 2009). These outcomes are identified by metrics such as, body-weight, BMI and obesity (BMI ≥30) while the set of explanatory correlates includes a wide range of economic, demographic, regional and lifestyle characteristics. The relevant empirical evidence is based on data drawn from national representative surveys concerning individuals from the US (Cutler et al., 2003; Chou et al., 2004; Rashad, 2006 and Lakdawalla and Philipson, 2009), China (Ng et al., 2012), Taiwan (Kan and Tsai, 2004), Russia (Heineck, 2006) and several European countries (Michaud et al., 2006; Garcia Villar and Quintana-Domeque, 2009 and Costa-Font et al., 2009). As far as Greece is concerned, the evidence on the determinants of body weight is scarce, rather selective regarding its determinants and it is typically included in comparative studies at the European level. For example, Garcia Villar and Quintana-Domeque (2009) utilize data from the European Community Household Panel (ECHP) for the period 1998-2001 to investigate the relationship between household income and body mass index (BMI) in nine EU countries including Greece. Moreover, Michaud et al. (2006) apply data from the Survey of Health, Aging and Retirement in Europe (SHARE) -concerning individuals, including Greeks, older than 50 years old- to analyze and compare the US/EU obesity prevalence rates. Although Greece is a country with a long transition in Mediterranean diet, a diet that could be negatively associated with obesity (Panagiotakos et al., 2006), evidence of a transition from the Mediterranean to western-type diets could be found. This issue, accompanied with behavioral changes, may lead to the excessive body weight in the case of

Greece (Kapantais et al. 2005). Indeed, according to the OECD Health Database, Greece belongs to the top 10 percent of the countries with the highest daily per capita calorie consumption (average values for the period 2000-2007). In addition, physical activity in Greece exhibits the lowest rates amongst other European countries (survey data drawn from the 2009 Eurobarometer, No. 72.3). The present study is an attempt to provide -for the first time- consolidated evidence for the Greek population regarding body weight outcomes, utilizing the most recent database (GNHS-2009) with information on body-size measures.

In this study BMI was treated both as cardinal and ordinal measure of body-weight while different estimation techniques were applied such as OLS, ordered probit and unconditional quantile regressions (UQR).[2] We argued for the inferiority of the UQR techniques (Firpo et al., 2009), as compared to the other models, since allow for exploring the entire distribution of BMI and identifying the differentiated impact of the covariate of interest at distinct points of the BMI distribution, holding all other variables constant. Given that the health-related risks are not homogenous across the BMI distribution, individuals may differentiate their responses to changes in correlates associated with body-weight outcomes. Costa-Font et al., (2009) suggest that the adoption of a quantile regression analysis of the BMI distribution is preferable to standard linear models precisely because the latter cannot provide insights about the differentiated impact of a certain variable at different points of the BMI distribution. Along the same lines, Lakdawalla and Philipson (2009) point out that individuals evaluate the costs and benefits of modifying their body weight depending on the level of their current body weight highlighting thus, the role of economic and social incentives that affect people's behavior and lifestyles. For instance, individuals of

[2] For conditional quantile approaches investigating the effect of family income and educational attainment in several European countries, including Greece, see Garcia Villar and Quintana-Domeque (2009) and Nakamura and Siciliani (2010).

higher schooling and excessive body weight are more likely to initiate adjustments and implement modifications leading to lower body weight, compared to individuals of higher schooling and normal weight, simply because the former face eminent health-related risks (Chou et al., 2004). Since our data availability, we apply a wide range of covariates including individual information on demographic characteristics (age, country of birth, gender), education, marital status, employment outcomes, household size and income, physical activity, smoking and drinking behaviour, general health status, consumption of fruits/vegetables/juices, psychological factors (anxiety/depression), regional indicators and the degree of urbanization regarding current residence.

Regarding the results obtained from the non-linear models of BMI we should point out that significant differences arise between estimation different estimation techniques. The unconditional quantile estimates (UQR) help us to uncover differences on the estimated impact of several correlates across the BMI distribution highlighting its superiority against simple linear models of BMI. According to our results males' BMI is positively associated with age, marriage, family income, disability and the BMI dispersion at the region of residence. Negative effects are exercised by education, being economically inactive and smoking. Similar results have been found for females with the exception of labour market outcomes where retired women have higher BMI values and part-time worker have lower. Additional effects have been found for several covariates. For example, positive effects are exercised by native born, family size and deteriorated health status. Negative effects were found for time spend walking and consumption of juices. The obtained results in the present study -regarding the determinants of BMI- do not seem to differ in any substantial way from those obtained by researchers who utilized data from other countries. However, our results cannot be compared with other relevant studies since there is only one study that uses unconditional quantile regression techniques (Jolliffe, 2011), which however concentrates only on the effect of low income on BMI. In addition the available literature in Greece provides evidence on the determinants of discrete body-weight measures such as obesity or applies conditional quantile regression techniques our results are not directly comparable to these studies. Thus our results are not directly comparable with these studies as well. Nevertheless, the provided in this study evidence could be helpful for designing and implementing appropriate public health policies in a country of increased obesity prevalence.

The paper is structured as follows. Section II describes the data and provides summary statistics of prevalence and distributional-sensitive measures of body-weight by gender. In Section III the explanatory covariates and the utilized empirical strategy are presented. Afterwards, in Section IV we present and discuss our results. The study concludes with Section V, containing a brief summary of the major findings.

II. Data

II.1 Data sources

Individual micro data are drawn from the GNHS, administered in the last quarter of 2009 by the Hellenic Statistical Authority (EL.STAT.). The GNHS is based on a series of personal-household interviews aiming at the creation of a large nationally representative database concerning health-related behaviors, anthropometrics, disability and morbidity profiles of the over 15 Greek population.

Data on body weight and height are self-reported and are used to calculate individual's BMI. For the needs of this study we restrict our working sample to individuals aged between 20 and 70 years of age. Younger respondents are excluded to alleviate concerns with respect to the puberty-related body weight/height growth (e.g., Power et al., 1997). Very old respondents are also excluded since they most likely face morphological changes in the vertebral column inducing thus variations on anthropometric characteristics that may bias our results (WHO, 1995).

Since the body weight/height values are self-reported in the GNHS, one should be aware of potential biases due to misreporting. These biases may be associated with misclassifications across body-weight categories, precision loses and certainly biased estimations. To deal with this problem Cawley (2004b) brings into the analysis additional data-sources, in which both self-reported and measured anthropometric characteristics were jointly available, and makes the necessary adjustments. Unfortunately, due to lack of data a similar analysis for the case of Greece cannot be carried out. In an attempt to somewhat diminish the potential bias, we eliminate cases in which other family members were interviewed on behalf of the selected persons (proxy interviews stand at about 1 per cent of the sample). Moreover, our choice to exclude from the analysis very old respondents may prove to be beneficial in this respect since usually greater measurement errors are associated with elderly respondents (Kuczmarski et al., 2001).

Figure 1 depicts the BMI distribution, separately by gender. The horizontal lines represent the sample medians for the case of male (solid line) and female sub-samples. Although simple descriptive statistics reveal that males have on average significantly higher BMI values compared to the female sub-sample (26.65 vs. 25.32) the exploration of the entire BMI distribution could provide a clearer picture of this gap. Indeed, Figure 1 shows that males have higher BMI values until the 80^{th} percentile of the distribution and the BMI gender gap vanishes after this. Moreover, we can also observe that the BMI values increase much faster after the median of the BMI distribution for both genders. These observations indicate that the analysis of the BMI and the identification of its determinants need to be carried out separately by gender and at different points of the BMI distribution.

--Insert Figure 1 about here--

II.2 Summary statistics

Preliminary summary statistics of BMI (Panel A) as well as prevalence rates for the body-weight categories (Panel B) were presented in Table 1, separately by gender. Four major body-weight categories are defined following the classification proposed by WHO (1995): underweight (BMI<18.5), normal (18.5≤BMI<25), overweight (25≤BMI<30) and obese (BMI≥30). As it is also previously stated males have higher mean BMI values compared to the female-subsample whereas, females seem to experience a more dispersed BMI distribution compared to males, as the interquartile ratios show (BMI 90/10, 50/10 and 90/50). Evidence from the conventional body-weight categories indicate that the “underweight” is the least prevalent group since less than one per-cent of males and about 1.4 per cent of females experienced very low body-weight. Most of the females are of normal weight (about 52 per cent) while this proportion is lower and stands at 35.00 per cent in case of the male sub-sample. Males appear more frequently in the overweight category in comparison to females (47.05 vs. 30.80) while such gender-specific variations are absent in the obesity category.

--Insert Table 1 about here--

Undoubtedly, a more detailed analysis on the BMI distribution could be more informative. For instance, the obesity indicator (BMI≥30) treats all obese respondents as belonging to a homogeneous group and, thus, it conceals the BMI distribution within this group. Table 2 presents summary statistics across quantiles of the BMI distribution for both sub-samples. In both cases, we observe that the average BMI value follows an increasing pattern as we move to the right (higher quantiles) of the BMI distribution. Probably more importantly, BMI also appears to be more volatile (increased standard deviations) as we move to the right of the distribution, although its growth is not monotonic. It should be mentioned that the upper quantile pertains to morbid obese and thus identifies a homogeneous group of individuals in terms of increased health risks.

--Insert Table 2 about here--

III. Methodological considerations

III.1 Modelling body-mass

Within a household production function framework, the consumption behavior and in particular the demand for caloric intake and expenditure (net calorie intake) can be addressed. Specifically, it is argued that consumers use goods and services, purchased from the market, in combination with their own time to produce composite commodities that directly enter their utility function. For instance, the set of composite commodities includes health (depending –among other things- on food consumption and physical activity), the enjoyment of eating palatable food and the entertainment provided by eating with other people. While no one desires to be of excess weight, some people apparently gain more utility from food consumption than others (Chou et al, 2004; Rashad, 2006). This indicates that excess body weight could be regarded as an outcome of the subjective evaluation of the costs and benefits of standing at a certain body weight.

Following a similar rationale and the theoretical approach of Chou et al. (2004) and Rashad (2006), the BMI of an individual i at a given point in time t is a function of the accumulated energy balance (EB) and a vector of individual-specific variables (ε). Energy balance is defined as calories consumed minus calories spent across all time periods while the individual-specific variables include age, gender, race and genetic factors that reflect body-weight predisposition patters. Therefore, the BMI variable could be modeled as follows:

$$BMI_i = f[\sum_t (EB_i) , \varepsilon_i] \quad (1)$$

Since detailed information on calories consumed and spent are scarce, most BMI-related studies model body-weight outcomes by relying on individual, socioeconomic and behavioral characteristics (such as, education, income, marital status and smoking) that may affect the energy balance, calorie composition (since all calories are not the same) and the process of converting calorie imbalance into body weight changes. We note that the cross-sectional character of our data does not allow a dynamic empirical approach, according to which past and current shocks in the energy balance combined with observed and unobserved heterogeneity could be taken into consideration. Nevertheless, much of the empirical work on body-weight outcomes employs cross-sectional data implying a steady-state interpretation of the relationship between the underline determinants and the body-weight dependent variable of interest (Costa-Fond et al., 2009).

In the light of the above discussion, a large set of individual and household specific attributes are considered. Specifically, we use demographic characteristics (country of birth, age and marital status), education, employment status, family income and household size, life-style features (physical activity, smoking, drinking), food consumption (fruits, vegetables, juices and salads), health outcomes (mental diseases, chronic conditions and disability) and regional variation (region of residence, degree of urbanization and BMI regional dispersion). Details on the definitions of these variables are presented on Table 3.

Turning to the accumulated literature regarding the expected effects of the key explanatory correlates, it should be noted that it primarily refers to US studies and to a much lesser extent to

European or Asian ones. Apparently US natives record higher BMI than foreign born individuals probably implying the presence of different genetic endowments (Sanchez-Vaznaugh et al., 2008). In a similar line are the results for the case of UK (Averett et al., 2012). Nevertheless, these evidence could not be thought as definite. For example, immigrants in Sweden record substantially higher BMI levels than natives after adjustment for age, socio-economic status, physical activity and smoking habits (Wandell et al., 2004). Moreover, the relationship between age and body mass (BMI and/or obesity) has been extensively examined. The corresponding findings converge on the existence of an inverse-U shaped association between age and body weight in both US (Chou et al., 2004; Rashad, 2006) and Europe (Sanz-de-Galdeano, 2005). Evidence from US studies reveals that marriage exerts a positive effect on male body mass (BMI and/or obesity) while the results for female sub-samples seem to be inconclusive (Rashad, 2006; Lakdawalla and Philipson, 2004). On the other hand, evidence from European studies confirmed that positive relationship between marriage and obesity exists for both men and women (Sanz-de-Galdeano, 2005; Michaud et al., 2006). Schooling exerts a protective effect on BMI and obesity incidence in the US (Chou et al., 2004; Lakdawalla and Philipson, 2004; Rashad, 2006) and Europe (Sanz-de-Galdeano 2005; Michaud et al., 2006). In the latter case, the corresponding effect could be thought as a casual one with respect to the female sub-sample (Brunello, 2013).

Mixed evidence is reported for the association between labor market outcomes and body mass in the US. Increased labor participation may be negatively associated with body weight since it induces the consumption of more expensive/higher quality food (Gomis-Porqueras et al., 2011). On the other hand, the augmented opportunity cost of time experienced by the employed respondents may resulted into a positive effects of employment in body-weight outcomes (Norton and Han, 2008). Moreover, a modest positive association between retirement and BMI is reported by Chung et al. (2009) for a US sample. Turning to the empirical evidence regarding the link between family income and body-mass, an inverted-U shaped relationship is identified for the male sub-sample while a negative association is established for the female one (Lakdawalla and Philipson, 2004). The latter finding is confirmed for European samples (Villar and Quintana-Domeque, 2009). Household size does not associated with obesity in a definite way as evidence for a number of European counties show (Sanz-de-Galdeano, 2005). As expected, physical activity reduces the probability of being overweight or obese as well as the level of BMI in the US (Yen et al. 2009) and in Europe (Michaud, 2006). Smoking is negatively associated with body weight outcomes in both the US (Rashad, 2006) and Europe (Michaud, 2006). A positive effect of alcohol consumption on body weight is also expected (for instance, Baum and Ruhm, 2009 and Ng et al., 2012). Lastly, significant regional differences are identified in both the US (Chou et al. 2004; Rashad, 2006) and the European databases (Morris, 2007).

It is worth noting that there are a few studies on the socioeconomic determinants of obesity in Greece. The available evidence describe the presence of higher obesity rates for the natives compared to the immigrants, an inverted U-shaped relationship between obesity and age as well as a positive association between marriage and obesity (Tzotzas et al., 2008; Tzotzas et al., 2004; Sanz-de-Galdeano, 2005; Michaud et al., 2006). Moreover, Sanz-de-Galdeano (2005) and Nakamura and Siciliani (2010) provide evidence on the negative association between education and obesity that restricted to the female sub-sample whereas, Tzotzas et al. (2004) confirm this relationship for both males and females (although in a not-representative sample). Evidence for the effect of income on the overweight body-weight status where provided by Sanz-de-Galdeano (2005). Finally, both Michaud et al. (2005) and Tzotzas et al. (2004) find a potentially protective effect of physical activity on obesity in the case of Greece.

Summary statistics for the aforementioned explanatory correlates, at the mean and across the BMI distribution, are presented at Table 4 (Males) and Table 5 (Females). These descriptive statistics reveal significant disparities as one moves to the right of the BMI distribution, i.e., from lower to higher quantiles. For instance, younger respondents are most likely to be observed at the left tail of the BMI distribution while older at the right one. Similarly, married respondents and those with lower educational attainment are more likely to be observed at the right tail of the BMI distribution. Significant cross quantile differences are also observed for differences in labour market statuses (male and females) and family income (males). Physically inactive respondents, males and females, are more likely to be observed at the right tail while male and female smokers are more frequently observed at the left tail of the BMI distribution. Moreover, individuals suffering from various health-related conditions and being disabled are observed more frequently at the right part of the BMI distribution, while consumption of fruits and vegetables, including juices, are associated with lower BMI values.

--Insert Table 4 about here--

--Insert Table 5 about here--

III.2 Empirical models

Our empirical strategy consists of the estimation of econometric models of different nature. The first refers to a simple OLS specification of BMI determination (OLS), the second to a standard ordered probit model (OPROBIT) of BMI categories -normal, overweight and obesity- and the last to an unconditional quantile regression (UQR) model specification. We should point out that the OLS model is a linear specification of BMI while the other two fall in the non-linear category highlighting the differentiated effects at district body-weight categories (OPROBIT) or regimes of the BMI distribution (UQR). Specifically, with the OPROBIT model we will be able to identify the differentiated impact of several explanatory variables on the probability of getting at higher categories of BMI. However, since the WHO (2000) classification of BMI categories could be viewed as referential rather than definitive (Kan and Tsai, 2004), we also utilize quantile techniques. Unlike the Conditional Quantile Regression (CQR) specifications (Koenkel and Bassett, 1978) that model the conditional BMI distribution, we utilize UQR which will help us to identify the effect of a specific variable on the unconditional distribution of the BMI variable. For example, we are interested in the effect of age on BMI using the whole sample of individuals (UQR) and not the impact of age on BMI for a group of workers with specific characteristics (CQR). This exercise will allow us to illustrate how the impact of a certain covariate, say "age", could varies across different points of the unconditional BMI distribution.

The baseline empirical specification is a simple OLS regression of the form:

$$\ln(BMI_i) = \alpha + \boldsymbol{\beta X_i} + u_i \quad (2)$$

where, $\ln(BMI_i)$ is the natural logarithm of individual's (i) BMI, $\boldsymbol{X_i}$ represents the vector of the utilized explanatory correlates, α and $\boldsymbol{\beta}$ is a set of coefficients to be estimated and u_i stands for the error term. Nevertheless, ordinary least square models explore central tendencies or BMI variations of the "average" respondent. Since the "average" Greek respondent is a normal-weight individual who does not experience either very low BMI values (underweight)[3] or very high ones (classified as overweight or obese), it is not clear whether this method is sufficiently informative.

[3] Underweight could be also of particular importance, although it's extremely low prevalence, since it is associated with augmented mortality risks (Flegal et al., 2005).

That is, estimating models that go beyond the mean could be of potential interest especially for observations at the upper/lower tails of the BMI distribution.

In the case of the OPROBIT model we utilize the conventional body-weight categories ($j = 1, \ldots, 3$), i.e. normal weight (including underweight)[4], overweight and obese. In this context, the underlying latent variable F_i^* could be modeling as,

$$F_i^* = \boldsymbol{\beta X_i} + u_i \qquad (3)$$

where, $\boldsymbol{X_i}$ is a vector of the explanatory correlates of individual i, $\boldsymbol{\beta}$ is a set of coefficients to be estimated and u_i stands for the error term. However, the latent outcome F_i^* is not observed. What is observed is an array of body-weight outcomes in which individuals are classified to alternative BMI categories (ordinal scale) as follows,

$$F_i = j \; if \; \mu_{j-1} < F_i^* \leq \mu_j, \mathrm{j} = 1,2,3 \qquad (4)$$

where, it is assumed that $\mu_0 = -\infty$, $\mu_j \leq \mu_{j+1}$ and $\mu_m = \infty$. Given the assumptions of normality, the probability of classified in one of the fatness categories ($j = 1, \ldots, 3$) is given by,

$$P(F_i = j|\boldsymbol{X}) = \Phi\left(\mu_j - \boldsymbol{\beta X_i}\right) - \Phi\left(\mu_{j-1} - \boldsymbol{\beta X_i}\right) \qquad (5)$$

where, $\Phi(.)$ stands for the normal distribution function. For estimation purposes maximum likelihood methods were applied and marginal effects have been computed for interpretation purposes (Greene, 2003).

The aforementioned descriptive evidence uncovered differences between the “prevalence” and the “distributional-sensitive” measures, suggesting that the exploration of the entire BMI

[4] Since underweight account for about 1 per cent of the population, for estimation purposes this category is also included in the normal weight group. Nevertheless, excluding underweight from our sample does not significantly alter our results.

distribution is preferred to the investigation of specific cut-points or mean values. Additionally, focusing on the entire BMI distribution could also be more consistent with medical studies which argue that individuals of excess weight experience increased health-risks as their BMI increases, indicating that each point of the distribution is associated with different risk (e.g., Willet et al.,1999; Freedman et al., 2002; Jolliffe, 2011). For these reasons a growing number of recent studies utilize quantile regression techniques and explore the entire BMI distribution (e.g., Kan and Tsai, 2004; Costa-Font et al., 2009; Stifel and Averett, 2009; Jolliffe, 2011). However, the above studies, with the exception of Jolliffe (2011), utilize Conditional Quantile Regression (CQR) models. However, in the present study we implement the newly proposed Unconditional Quantile Regression (Firpo et al., 2009). The UQR technique identifies the effect of the explanatory variables at different points of the unconditional distribution, holding everything else constant (i.e., ceteris paribus). That is, we are interested in estimating the impact of a given correlate on BMI using the entire sample of heterogeneous respondents (unconditional effects) rather than the impact on a sub-sample with specific characteristics, i.e., the conditional effects. Therefore, for the purposes of the present study, the UQR techniques are preferred to CQR ones. The implemented UQR models are based on a re-centered influence function (RIF) that assumes a linear specification,

$$E[RIF(ln(BMI_i); q_\tau | \boldsymbol{X_i})] = \boldsymbol{\beta X_i} \qquad (6)$$

where, $\boldsymbol{X_i}$ represents a vector of the explanatory covariates for each individual (i) and $\boldsymbol{\beta}$ is the se of coefficients to be estimated across quantiles (q_τ). To obtain unbiased estimates of the variance-covariance matrix, in the presence of heteroskedasticity, bootstrapped methods with 1000 replications were applied. Both, the baseline OLS model and the UQR models are estimated separately for the male and female sub-sample.

IV. Estimation results

IV.1 OLS

Estimation results from simple baseline OLS specifications are presented at Table 6, separately for the male and female subs-samples. With respect to males, we observe that age is positively but non-monotonically associated with BMI. Specifically, it appears that the BMI increases as one becomes older until the age of 59 and then it begins to decline. Single and separated/divorced males have on average lower BMI values in comparison to their married counterparts. Educational attainment seems to be negatively associated with BMI outcomes. Indeed, males of primary (secondary) education experience higher BMI values, by about 2.5 per cent (2.6 per cent), compared to those who completed tertiary education. Furthermore, economically inactive males have lower BMI values by about 4.7 per cent in comparison to full time workers. Males with family income between 901 and 1,400 euros per month and above 2,100 euros per month have higher BMI values than those males encountered at the left tail of the income distribution (below 900 euros per month). Therefore, family income seems to be positively associated with BMI. As expected, smoking is associated with lower BMI values. Physical disabilities seem to be associated with higher BMI values, by about 4.0 per cent in comparison to males without any physical impairment. Lastly, as the region-specific BMI dispersion increases, BMI also increases. This positive association probably indicates that living in regions where the BMI gap between the heavier and the thinner male respondents is quite high may be linked with increased BMI values.

Turning to the female sub-sample, the estimation results show that natives experience higher BMI values, by about 2.3 per cent, compared to foreigners. Again, age is positively and non-monotonically associated with BMI. Being single is associated with a lower BMI by about

4.2 per cent compared to married respondents. Moreover, those of lower schooling (primary or secondary education) experience higher BMI values compared to females with tertiary education (about 4.0 and 2.6 per cent higher, respectively). In comparison to full-time, part-time workers experience lower BMI by about 3.2 per cent, whereas retired females have, on average, 2.7 per cent higher BMI values. Women in households of higher sizes seem to be characterized by increased BMI values. Physical activity (hours of walking) is negatively correlated with BMI. For instance, a ten per cent increase in the amount of walking hours is associated with a BMI reduction of about 3.0 per cent. Females who enrich their diet with fruits and vegetables including juices have one average lower BMI values by about 1.5 per cent in comparison to those with a different dietary profile. As expected, smoking is associated with lower BMI values by about 3.1 per cent, on average. Furthermore, women suffering from long-standing illnesses or experiencing disability impairment exhibit higher BMI values, by about 4.5 and 4.6 per cent, respectively. Lastly, women residing in urban areas have lower BMI than those in rural centers.

--Insert Table 6 about here--

IV.2 OPROBIT

Table 7 presents, by gender, the marginal effects of the OPROBIT specification. The effect of age on the probability of being at higher BMI categories is positive and non-monotonic. For example, a male respondent of age 50-59 faces increased probability (20.6 percent) of being obese and only 2.8 percent of being overweight. In other words, being in the age bracket 50-59, increases the likelihood of being observed in the overweight and obese categories and decreases the likelihood of being classified in the normal one. Single males face increased probabilities of being normal and reduced likelihood of being overweight or obese. The same holds for widowed and divorced respondents. In the comparison to respondents with tertiary education, males of lower educational attainment (primary and secondary) have increased likelihood of being in the overweight and obese categories. Inactivity increases the likelihood of being classified as normal and thus, decreases the likelihood of being overweight or obese. Compared to low income families, it appears that males in families with medium income have higher probabilities of being classified as overweight or obese and lower probability of falling in the normal BMI category. Family size increases the probability of being classified as normal while disabled males have higher probability of being classified as overweight or obese.

Concerning female respondents, we observe that similar effects to those of men are recorded for age, marital status, education and disability. In addition, natives have increased probability of being classified as overweight or obese. Retirement also increases the likelihood of being in higher BMI categories and decreases the probability of being of normal weight. Inactive respondents have a higher likelihood of being in the higher BMI categories while women with increased physical activity have a lower probability of being observed in these categories. Eating habits also seem to play a role in the cases of women. For instance, women consuming juices have a lower probability of being overweight or obese. Exactly the same holds for female smokers while the opposite is true for women with deteriorating health status. Lastly, regional variation seems to characterize the probability of being classified in one of the three BMI categories and in particular, women residing in urban areas have lower probability of being classified in the upper two BMI categories.

--Insert Table 7 about here--

IV.3 UQR

Estimation results from the UQR for the male sub-sample are presented at Table 8. At the first glance it is evident that age is positively and non-monotonically correlated with BMI. However, the UQR coefficients of the age groups 30-39, 40-49, 50-59 and 60-70 decrease significantly as we move to the right of the BMI distribution (compared to the reference 20-29 age group). At this point, we note that at the highest right-tail of the BMI distribution, i.e., the 90th percentile, these reductions result in non-significant age-group coefficients (except for the 40-49 age group). Overall, these results indicate that the positive effect of age is relatively more evident in the case of the thinner respondents (at the left tail of the BMI distribution). Being single or separated/divorced is negatively correlated with BMI, except for those respondents at the right and left tails of the BMI distribution indicating that marital statuses do not seem to be relevant in the case of underweight respondents and those with very high body-weight outcomes. However, the size of the corresponding coefficients reveals a practically constant -in magnitude- effect across those quantiles of the BMI distribution in which the marital status does matter. Indeed, the null hypothesis for the equality of the coefficients across quantiles is not rejected.[5] The coefficient of the primary education group, (tertiary education is the reference group), is positive and statistically significant at about the median and the high end of the BMI distribution. In the latter case, the corresponding coefficient is twice the size of the coefficient at the median of the BMI distribution (0.065 vs. 0.032). The corresponding coefficients of the secondary education group show that as one moves from the median to the high end of the BMI distribution the effect of the variable in question follows an increasing pattern (increase from about 0.022 at the median to 0.42 at the right tail), albeit with fluctuations. Therefore, despite OLS evidence which suggests that

[5] Typical statistical tests for the null hypothesis that the coefficients are equal across quantiles were estimated. The corresponding results are not shown but are available upon request.

there is a constant association, UQR estimates suggest that the adverse effect of lower educational attainment is more harmful as one moves to the right of the BMI distribution. With respect to the labour market statuses, being retired is associated with higher BMI values only at the far-right tail of the BMI distribution (90^{th} percentile), in comparison to the full-time workers (reference category). On the other hand, being inactive is associated with a protective effect at the median of the BMI distribution and, more intensely, at the right tail, in comparison to full-time workers. Turning to the family income groups, those reporting income in the second bracket (between 901 and 1,400 euros per month) experience higher BMI values in comparison to those belonging in the first decile, below 900 euros per month. On the other hand, belonging to the higher family income group (above 2,100 euros per month) exerts a positive effect on BMI that is limited to those who have relatively low BMI values (25^{th} - 50^{th} quantiles). Family size is negatively correlated with BMI but only for the 10^{th} and the 25^{th} quantiles. Evidence reveals considerable variations in the effect of smoking. Indeed, it appears that smoking exerts a negative effect at the lowest left tail as well as at about the median of the BMI distribution. No effect is identified at higher quantiles. The positive association between disability and BMI is highly significant and increasing in magnitude as we move to the right of the BMI distribution. Finally, the coefficients of the region-specific BMI dispersion become statistically significant after the 75^{th} quantile, showing that males who reside in regions where the BMI dispersion is high face more severe body-weight outcomes.

--Insert Table 8 about here--

Results for females (Table 9) reveal similarities in the effect of the covariates on the distribution of BMI compared to those from the male sub-sample. Indeed, as in males, age exerts a positive and non-monotonic effect on BMI. Moreover, a closer look on the estimated coefficients across quantiles of the BMI distribution show that unlike the flat effects from the OLS models, the age-group coefficients vary in magnitude and some of them lost their statistical significance, as moving to the right of the BMI distribution. This probably indicates that the positive effect of age is considerably reducing in case of the females who experienced excess body-weight. Being single is negatively associated with BMI, a result which however shows minor fluctuations across quantiles of the BMI distribution. Moreover, women of primary education follow increasing patterns as we move to the right of the BMI distribution (from 0.039 in the 25th to 0.067 in the 75th quantile) and it becomes insignificant at the far-right tail of the distribution. Analogously, secondary education seems to exert a positive effect on BMI but of lower magnitude. Females who work part-time, as opposed to full-time, are concentrated at the left-tail of the BMI distribution. Retirement is associated with positive effects at the left of the median of the BMI distribution. Living in families of increased size is associated with higher BMI but only for those at the 25th quintile. Smoking exerts a U-shaped effect. More specifically, the negative effect of smoking becomes stronger as we move towards the center of the distribution. Suffering from long-standing health condition or experiencing disabilities are associated with a positive and increasing -in magnitude- effect on BMI as we move from the lowest to the highest quantiles. Lastly, living in regions with a higher BMI dispersion is associated with higher BMI only at the 75th quintile.

--Insert Table 9 about here--

Overall, the obtained results from the OLS and OPROBIT specifications do not seem to differ -in any substantive way- from those obtained by researchers who utilized data from other countries, worldwide. However, our results cannot be directly compared with past relevant studies because the unique available study applying UQR techniques (Jolliffe, 2011) concentrates on the effect of low income on BMI. Regarding Greece, the available literature contains evidence on the determinants of discrete body-weight measures such as obesity (Sanz-de-Galdeano, 2005 and Michaud et al., 2006), or applies conditional quantile regression techniques (Garcia Villar and Quintanna-Domeque, 2009 and Nakamura and Siciliani, 2010). In addition, the related clinical literature is mainly based on non-representative samples of the Greek population (for instance, Manios et al., 2005; Tzotzas et al., 2005). Lastly, we point out that the identified -herein- associations between the "explanatory" covariates and BMI outcomes cannot be interpreted as causal since several confounding mechanisms may be in operation.

V. Conclusions

In this study explores the determinants of BMI in Greece applying, for the first time, recently released data from the National Health Survey (GNHS-2009). We utilized different estimation techniques such as OLS, ordered probit and unconditional quantile regression and we apply them separately to male and female sub-samples. The obtained results indicate that the BMI of Greek men is positively associated with age (non-monotonically), marriage, family income, disability and the BMI dispersion at the region of residence. Negative effects are exercised by education, being economically inactive and smoking. Similar results are identified for females with the exception of labour market outcomes where retired women have higher BMI values and part-time worker have lower. Additional effects have been found for several covariates. Indeed, positive effects are exercised by native born, family size and deteriorated health status whereas, negative effects were found for walking activities and consumption of juices.

Turning now to the results obtained from the non-linear models of BMI, several quantitative and qualitative differences, vis-à-vis the results of the linear OLS model, are observed. The differences are more significant when the comparison is made with the results of the unconditional quantile regressions and less important when the BMI is modelled as an ordered choice variable. For instance, the results of the ordered probit model (unlike the OLS) for the male sub-sample indicate that family size and physical activity exert statistically significant effects. The same holds for the female sub-sample where significant effects have been identified for the economic inactivity and family income. Apparently, the OLS results vis-à-vis those of the unconditional quantile regression models, either fail to identify the effect of some BMI correlates at certain quantiles or mask important differentiated effects across the entire BMI distribution.

Although the identified associations of BMI and its correlates cannot be considered as causal, the results of the present study clearly indicate that Greek policymakers should rely on results originating from empirical models and estimation techniques that go beyond the mean of the BMI distribution. Examining the entire BMI distribution and targeting specific segments of the Greek population can render public health policies against obesity more efficient and prolific.

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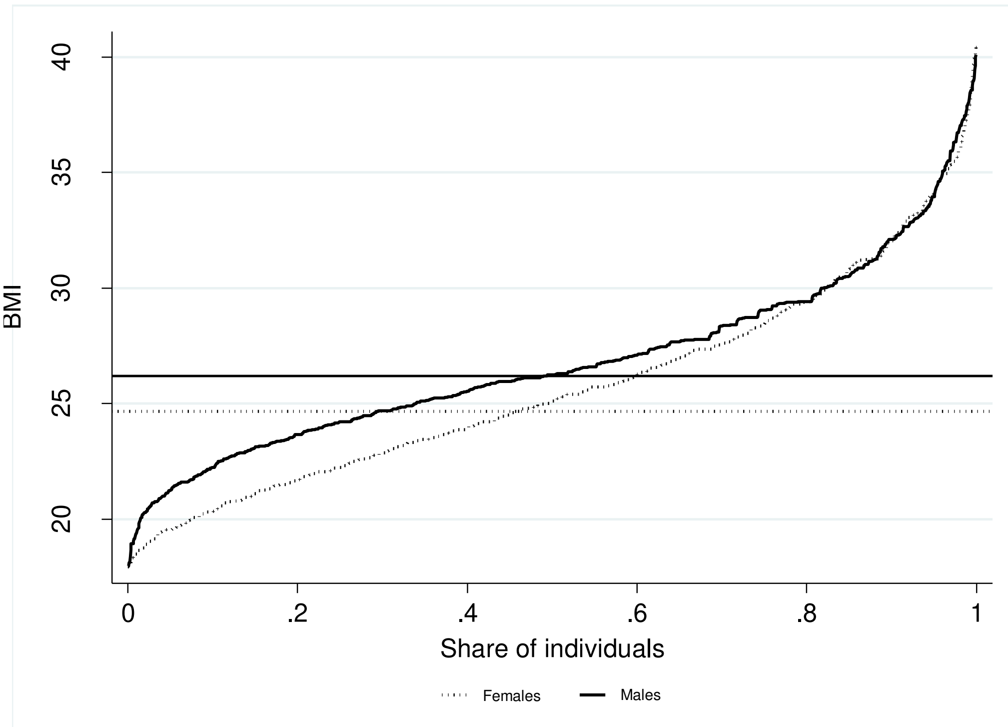
Figures

Figure 1. Distribution of BMI for males and females



Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).
Note: The horizontal lines represent the sample medians by gender.

Tables

Table 1. Summary statistics of BMI by gender

	Males	Females
Panel A: Summary statistics		
Number of observations	1703	2542
BMI (Mean)	26.65	25.32
BMI (Median)	26.20	24.65
BMI (Min)	17.96	17.93
BMI (Max)	40.09	40.40
BMI (90/10)	1.45	1.57
BMI (50/10)	1.19	1.23
BMI (90/50)	1.22	1.28
Panel B: BMI composition		
Underweight	0.226	1.37
Normal	35.23	51.89
Overweight	47.05	30.80
Obese	17.49	15.95
Total	100.00	100.00

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT). In case of the BMI composition (Panel B), both the prevalence rates and the corresponding standard deviations were multiplied by 100. Descriptive statistics were calculated using sampling weights.

Table 2. Mean BMI for each BMI quantile and by gender

BMI quantile	Males					Females				
	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max	Obs.
0-10	20.81	0.96	17.96	21.97	150	19.22	0.56	17.93	20.06	195
10-25	23.11	0.53	22.30	24.00	243	21.03	0.54	20.07	21.90	350
25-50	25.17	0.66	24.02	26.17	441	23.24	0.80	21.91	24.62	623
50-75	27.37	0.81	26.20	29.05	441	26.15	0.95	24.65	27.89	664
75-90	30.07	0.80	29.06	31.99	249	29.64	1.09	27.92	31.53	427
90-100	34.49	2.12	32.00	40.09	179	34.37	2.09	31.55	40.40	283

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT). Descriptive statistics were calculated using sampling weights.

Table 3. Definition of variables

Dependent variable	
lnBMI	Natural logarithm of individual's BMI
NORMAL	=1 if BMI<25; 0 otherwise
OVERWEIGHT	=1 if 25≤BMI<30; 0 otherwise
OBESE	=1 if BMI≥30; 0 otherwise
Independent variable	
NATIVE	=1 if the respondent's country of birth is Greece; 0 otherwise
AGE2029	=1 if respondent aged between 20 and 29 years old; 0 otherwise
AGE3039	=1 if respondent aged between 30 and 39 years old; 0 otherwise
AGE4049	=1 if respondent aged between 40 and 49 years old; 0 otherwise
AGE5059	=1 if respondent aged between 50 and 59 years old; 0 otherwise
AGE6070	=1 if respondent aged between 60 and 70 years old; 0 otherwise
MARRIED	=1 if respondent is married; 0 otherwise
SINGLE	=1 if respondent is single; 0 otherwise
WIDDIV	=1 if respondent is widowed/divorced; 0 otherwise
PRIMED	=1 if completed less than the first stage of secondary education (ISCED 1); 0 otherwise
SECED	=1 if completed any type of secondary or post-secondary, but not tertiary, education (ISCED 2,3 and 4); 0 otherwise
TERED	=1 if completed any stage of tertiary education (ISCED 5 and 6); 0 otherwise
FTWORK	=1 if the respondent is a full-time worker; 0 otherwise
PTWORK	=1 if the respondent is a part-time worker; 0 otherwise
UNEM	=1 if the respondent is unemployed; 0 otherwise
RETIRE	=1 if the respondent is retired; 0 otherwise
INACTIVE	=1 if the respondent is inactive; 0 otherwise
FAMIINC1	=1 if the net family income is less than 901 € per month; 0 otherwise
FAMIINC2	=1 if the net family income is between 901 and 1400 € per month; 0 otherwise
FAMIINC3	=1 if the net family income is between 1401 and 2100 € per month; 0 otherwise
FAMIINC4	=1 if the net family income is above 2101 € per month; 0 otherwise
FAMINCM	=1 if the net family income is missing; 0 otherwise
FSIZE	Total number of persons in the household
PHYSINAC	=1 if the respondent belong to the lower quantiles of the MET-min per week; 0 otherwise. To derive MET-min per week (that accounts for both the intensity and the time spend on physical activities) we assign 4 MET to each reported minute of moderate physical activity -that was implemented in the previous 7 days- and 8 MET/min in the case of the vigorous activities (Craig et al., 2003).
MODACT	=1 if the respondent belong to the median quantile of the MET-min per week; 0 otherwise.
VIGACT	=1 if the respondent belong to the higher quantiles of the MET-min per week; 0 otherwise.
LNHWALK	Natural logarithm of hours spend in walking during the past week.
FRUITS	=1 if respondent consumes fruits at least once a week; 0 otherwise
VEGSAL	=1 if respondent consumes vegetables or salads at least once a week; 0 otherwise
JUICE	=1 if respondent drinks fruit or vegetable juices or at least once a week; 0 otherwise
SMOKE	=1 if respondent smokes; 0 otherwise.
EXCDRINK	=1 if respondent drinks 6 or more alcohol drinks in one occasion; 0 otherwise
HEALTHCON	=1 if suffered from any long-lasting health condition; 0 otherwise
ANXIETY	=1 if suffered from chronic anxiety; 0 otherwise
DEPRESS	=1 if suffered from chronic depression; 0 otherwise
DISABLE	=1 if the respondent experienced any limitation in physical functions (walking in flat terrain, walking down/up stairs, bend and kneel, carry a weigh, grasp and handle, bite and chew) and/or activities of daily living (feeding, getting in/out of the bed, dressing, using toilet and bathing); 0 otherwise
REGBMI	BMI interquartile range at a regional and urbanizational level; 0 otherwise
EASTMACED	=1 if region of residence is "East Macedonia and Thrace"; 0 otherwise
CENTRMACED	=1 if region of residence is "Central Macedonia"; 0 otherwise
WESTMACED	=1 if region of residence is "West Macedonia"; 0 otherwise
THESSALY	=1 if region of residence is "Thessaly"; 0 otherwise
EPIRUS	=1 if region of residence is "Epirus"; 0 otherwise
IONIANISLANDS	=1 if region of residence is "Ionian Islands"; 0 otherwise
WESTHGR	=1 if region of residence is "West Greece"; 0 otherwise
CENTRALGR	=1 if region of residence is "Central Greece"; 0 otherwise
PELOP	=1 if region of residence is "Peloponnese"; 0 otherwise
ATTICA	=1 if region of residence is "Attica"; 0 otherwise
NAEGEAN	=1 if region of residence is "North Aegean"; 0 otherwise
SAEGEAN	=1 if region of residence is "South Aegean"; 0 otherwise
CRETE	=1 if region of residence is "Crete"; 0 otherwise
URBAN	=1 if respondent living in a decently-populated; 0 otherwise
SEMIURB	=1 if respondent living in a intermediately-populated area; 0 otherwise
RURAL	=1 respondent living in a rural area; 0 otherwise

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).

Table 4. Descriptive statistics across quantiles of the BMI distribution: Males

Variables	*BMI quantiles* 0-10% (I)	10-25% (II)	25-50% (III)	50-75% (IV)	75-90% (V)	90 -100% (VI)	*Mean*
NATIVE	0.89 (0.31)	0.81 (0.39)	0.90 (0.30)	0.92 (0.27)	0.90 (0.30)	0.90 (0.30)	0.89 (0.31)
AGE2029	0.55 (0.50)	0.36 (0.48)	0.19 (0.39)	0.10 (0.30)	0.11 (0.31)	0.08 (0.27)	0.21 (0.41)
AGE3039	0.16 (0.36)	0.26 (0.44)	0.18 (0.39)	0.25 (0.43)	0.22 (0.42)	0.16 (0.37)	0.21 (0.41)
AGE4049	0.13 (0.33)	0.17 (0.38)	0.23 (0.42)	0.23 (0.42)	0.24 (0.43)	0.26 (0.44)	0.22 (0.41)
AGE5059	0.09 (0.29)	0.09 (0.29)	0.22 (0.41)	0.24 (0.42)	0.21 (0.41)	0.24 (0.43)	0.19 (0.39)
AGE6070	0.07 (0.26)	0.11 (0.32)	0.18 (0.39)	0.18 (0.39)	0.22 (0.41)	0.25 (0.43)	0.17 (0.38)
MARRIED	0.36 (0.48)	0.48 (0.50)	0.66 (0.47)	0.73 (0.44)	0.76 (0.43)	0.79 (0.41)	0.65 (0.48)
SINGLE	0.62 (0.49)	0.47 (0.50)	0.30 (0.46)	0.24 (0.43)	0.21 (0.41)	0.19 (0.39)	0.32 (0.47)
WIDDIV	0.02 (0.13)	0.05 (0.22)	0.04 (0.19)	0.03 (0.17)	0.03 (0.16)	0.02 (0.15)	0.03 (0.18)
PRIMED	0.19 (0.39)	0.18 (0.38)	0.15 (0.36)	0.23 (0.42)	0.18 (0.38)	0.29 (0.45)	0.19 (0.39)
SECED	0.52 (0.50)	0.51 (0.50)	0.52 (0.50)	0.47 (0.50)	0.58 (0.49)	0.50 (0.50)	0.52 (0.50)
TERED	0.29 (0.45)	0.31 (0.46)	0.32 (0.47)	0.31 (0.46)	0.24 (0.43)	0.21 (0.41)	0.29 (0.45)
FTWORK	0.56 (0.50)	0.68 (0.47)	0.69 (0.46)	0.69 (0.46)	0.66 (0.47)	0.61 (0.49)	0.66 (0.47)
PTWORK	0.03 (0.18)	0.04 (0.19)	0.10 (0.10)	0.03 (0.17)	0.14 (0.12)	0.01 (0.11)	0.02 (0.15)
UNEM	0.13 (0.33)	0.06 (0.25)	0.53 (0.22)	0.05 (0.22)	0.08 (0.28)	0.09 (0.28)	0.07 (0.25)
RETIRE	0.07 (0.25)	0.10 (0.31)	0.17 (0.37)	0.19 (0.39)	0.17 (0.38)	0.29 (0.45)	0.17 (0.37)
INACTIVE	0.22 (0.41)	0.11 (0.32)	0.08 (0.28)	0.04 (0.16)	0.08 (0.25)	0.01 (0.10)	0.08 (0.27)
FAMIINC1	0.14 (0.34)	0.12 (0.32)	0.09 (0.28)	0.08 (0.27)	0.10 (0.31)	0.06 (0.24)	0.09 (0.29)
FAMIINC2	0.13 (0.34)	0.17 (0.38)	0.21 (0.41)	0.19 (0.39)	0.24 (0.43)	0.25 (0.44)	0.20 (0.40)
FAMIINC3	0.29 (0.45)	0.31 (0.46)	0.29 (0.45)	0.29 (0.45)	0.27 (0.45)	0.29 (0.46)	0.29 (0.45)
FAMIINC4	0.32 (0.47)	0.30 (0.46)	0.32 (0.47)	0.34 (0.47)	0.30 (0.46)	0.30 (0.46)	0.32 (0.47)
FAMINCM	0.12 (0.33)	0.10 (0.30)	0.10 (0.30)	0.11 (0.31)	0.08 (0.26)	0.30 (0.46)	0.10 (0.30)
FSIZE	3.34 (1.04)	3.22 (1.06)	3.14 (1.05)	3.15 (1.04)	3.28 (0.97)	3.31 (1.35)	3.21 (1.07)
PHYSINAC	0.38 (0.49)	0.31 (0.47)	0.39 (0.49)	0.37 (0.48)	0.44 (0.50)	0.47 (0.50)	0.38 (0.49)
MODACT	0.34 (0.48)	0.37 (0.49)	0.33 (0.47)	0.34 (0.47)	0.32 (0.47)	0.28 (0.45)	0.34 (0.48)
VIGACT	0.27 (0.45)	0.31 (0.46)	0.28 (0.45)	0.29 (0.45)	0.23 (0.42)	0.25 (0.44)	0.27 (0.45)
LNHWALK	4.51 (1.90)	4.33 (2.04)	4.46 (2.10)	4.17 (2.16)	4.53 (1.96)	4.08 (2.33)	4.35 (2.09)
FRUITS	0.86 (0.35)	0.89 (0.31)	0.90 (0.30)	0.90 (0.31)	0.93 (0.25)	0.88 (0.33)	0.90 (0.30)
VEGSAL	0.94 (0.24)	0.94 (0.25)	0.95 (0.21)	0.96 (0.21)	0.97 (0.18)	0.97 (0.17)	0.95 (0.21)
JUICE	0.70 (0.46)	0.64 (0.48)	0.62 (0.49)	0.54 (0.50)	0.63 (0.48)	0.59 (0.49)	0.61 (0.49)
SMOKE	0.67 (0.47)	0.44 (0.50)	0.52 (0.50)	0.48 (0.50)	0.46 (0.50)	0.49 (0.50)	0.50 (0.50)
EXCDRINK	0.04 (0.20)	0.05 (0.22)	0.06 (0.23)	0.05 (0.23)	0.06 (0.24)	0.07 (0.26)	0.24 (0.43)
HEALTHCON	0.21 (0.41)	0.20 (0.40)	0.29 (0.45)	0.28 (0.45)	0.28 (0.45)	0.37 (0.49)	0.27 (0.45)
ANXIETY	0.01 (0.09)	0.02 (0.15)	0.02 (0.14)	0.04 (0.20)	0.02 (0.14)	0.03 (0.08)	0.03 (0.16)
DEPRESS	0.01 (0.09)	0.01 (0.12)	0.01 (0.08)	0.01 (0.09)	0.01 (0.10)	0.01 (0.09)	0.01 (0.09)
DISABLE	0.07 (0.25)	0.11 (0.31)	0.11 (0.32)	0.15 (0.36)	0.19 (0.39)	0.28 (0.45)	0.14 (0.35)
REGBMI	5.57 (0.53)	5.56 (0.56)	5.52 (0.65)	5.51 (0.71)	5.67 (0.59)	5.75 (0.62)	5.57 (0.64)

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).
Notes: Standard deviations in parenthesis. Descriptive statistics were calculated using sampling weights.

Table 5. Descriptive statistics across quantiles of the BMI distribution: Females

Variables	*BMI quantiles* 0-10% (I)	10-25% (II)	25-50% (III)	50-75% (IV)	75-90% (V)	90 -100% (VI)	*Mean*
NATIVE	0.84 (0.37)	0.85 (0.36)	0.87 (0.34)	0.92 (0.27)	0.94 (0.25)	0.91 (0.29)	0.89 (0.31)
AGE2029	0.47 (0.50)	0.26 (0.44)	0.18 (0.39)	0.10 (0.30)	0.09 (0.29)	0.03 (0.18)	0.18 (0.38)
AGE3039	0.34 (0.48)	0.37 (0.48)	0.26 (0.44)	0.17 (0.38)	0.07 (0.26)	0.14 (0.34)	0.22 (0.42)
AGE4049	0.12 (0.33)	0.21 (0.41)	0.28 (0.45)	0.27 (0.44)	0.21 (0.41)	0.21 (0.41)	0.23 (0.42)
AGE5059	0.05 (0.22)	0.08 (0.28)	0.16 (0.37)	0.22 (0.41)	0.30 (0.46)	0.32 (0.46)	0.19 (0.39)
AGE6070	0.01 (0.11)	0.07 (0.25)	0.11 (0.32)	0.24 (0.43)	0.33 (0.47)	0.29 (0.46)	0.18 (0.38)
MARRIED	0.53 (0.50)	0.66 (0.47)	0.74 (0.44)	0.80 (0.40)	0.83 (0.38)	0.82 (0.38)	0.74 (0.44)
SINGLE	0.43 (0.50)	0.27 (0.45)	0.18 (0.38)	0.10 (0.31)	0.07 (0.25)	0.02 (0.14)	0.17 (0.37)
WIDDIV	0.05 (0.22)	0.06 (0.24)	0.08 (0.27)	0.10 (0.30)	0.10 (0.30)	0.16 (0.36)	0.09 (0.29)
PRIMED	0.07 (0.26)	0.08 (0.28)	0.18 (0.38)	0.31 (0.46)	0.45 (0.50)	0.40 (0.49)	0.25 (0.43)
SECED	0.56 (0.50)	0.53 (0.50)	0.56 (0.50)	0.49 (0.50)	0.42 (0.49)	0.45 (0.50)	0.51 (0.50)
TERED	0.37 (0.48)	0.38 (0.47)	0.26 (0.44)	0.20 (0.40)	0.13 (0.33)	0.15 (0.36)	0.24 (0.43)
FTWORK	0.46 (0.50)	0.57 (0.50)	0.44 (0.50)	0.35 (0.48)	0.31 (0.46)	0.26 (0.44)	0.40 (0.49)
PTWORK	0.12 (0.33)	0.06 (0.50)	0.04 (0.21)	0.04 (0.19)	0.03 (0.18)	0.03 (0.18)	0.05 (0.22)
UNEM	0.15 (0.35)	0.10 (0.30)	0.12 (0.32)	0.07 (0.25)	0.05 (0.23)	0.08 (0.27)	0.09 (0.29)
RETIRE	0.02 (0.14)	0.04 (0.19)	0.08 (0.28)	0.15 (0.36)	0.21 (0.41)	0.22 (0.41)	0.12 (0.32)
INACTIVE	0.25 (0.43)	0.23 (0.42)	0.31 (0.46)	0.39 (0.49)	0.39 (0.49)	0.41 (0.49)	0.33 (0.47)
FAMIINC1	0.12 (0.32)	0.11 (0.31)	0.15 (0.35)	0.12 (0.33)	0.18 (0.38)	0.17 (0.37)	0.14 (0.35)
FAMIINC2	0.25 (0.43)	0.16 (0.37)	0.19 (0.39)	0.20 (0.40)	0.26 (0.44)	0.26 (0.44)	0.21 (0.41)
FAMIINC3	0.26 (0.44)	0.26 (0.44)	0.25 (0.43)	0.31 (0.46)	0.22 (0.42)	0.26 (0.44)	0.26 (0.44)
FAMIINC4	0.28 (0.45)	0.49 (0.49)	0.30 (0.46)	0.25 (0.43)	0.24 (0.43)	0.22 (0.41)	0.28 (0.45)
FAMINCM	0.10 (0.31)	0.09 (0.28)	0.11 (0.32)	0.11 (0.31)	0.10 (0.29)	0.08 (0.28)	0.10 (0.30)
FSIZE	3.20 (1.11)	3.22 (1.04)	3.30 (1.07)	3.21 (1.05)	3.09 (1.06)	3.13 (1.05)	3.21 (1.06)
PHYSINAC	0.31 (0.46)	0.30 (0.46)	0.25 (0.43)	0.28 (0.45)	0.31 (0.46)	0.32 (0.47)	0.29 (0.45)
MODACT	0.35 (0.48)	0.38 (0.49)	0.38 (0.48)	0.37 (0.48)	0.33 (0.47)	0.39 (0.49)	0.37 (0.48)
VIGACT	0.35 (0.48)	0.32 (0.47)	0.38 (0.48)	0.35 (0.48)	0.37 (0.48)	0.29 (0.45)	0.35 (0.48)
LNHWALK	4.05 (2.19)	4.47 (1.93)	4.37 (2.03)	4.13 (2.19)	3.94 (2.34)	3.90 (2.27)	4.18 (2.15)
FRUITS	0.86 (0.35)	0.94 (0.24)	0.91 (0.28)	0.90 (0.30)	0.91 (0.29)	0.88 (0.31)	0.90 (0.29)
VEGSAL	0.92 (0.27)	0.98 (0.15)	0.97 (0.18)	0.96 (0.20)	0.96 (0.19)	0.95 (0.22)	0.96 (0.20)
JUICE	0.70 (0.46)	0.76 (0.43)	0.65 (0.48)	0.59 (0.49)	0.56 (0.50)	0.47 (0.50)	0.62 (0.48)
SMOKE	0.50 (0.50)	0.46 (0.50)	0.40 (0.49)	0.33 (0.47)	0.25 (0.43)	0.33 (0.47)	0.37 (0.48)
EXCDRINK	0.01 (0.09)	0.01 (0.08)	0.01 (0.12)	0.00 (0.07)	0.02 (0.04)	0.01 (0.09)	0.07 (0.25)
HEALTHCON	0.15 (0.36)	0.25 (0.43)	0.32 (0.47)	0.44 (0.50)	0.56 (0.50)	0.69 (0.46)	0.39 (0.49)
ANXIETY	0.02 (0.15)	0.05 (0.21)	0.05 (0.22)	0.06 (0.23)	0.09 (0.28)	0.08 (0.27)	0.06 (0.23)
DEPRESS	0.01 (0.11)	0.01 (0.12)	0.02 (0.13)	0.03 (0.16)	0.04 (0.21)	0.06 (0.24)	0.03 (0.16)
DISABLE	0.04 (0.20)	0.09 (0.29)	0.14 (0.36)	0.29 (0.45)	0.40 (0.49)	0.47 (0.50)	0.23 (0.42)
REGBMI	5.59 (0.57)	5.59 (0.66)	5.57 (0.67)	5.46 (0.72)	5.65 (0.69)	5.68 (0.63)	5.57 (0.68)

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).
Notes: Standard deviations in parenthesis. Descriptive statistics were calculated using sampling weights.

Table 6. OLS estimates of ln(BMI), separately by gender.

	Males		Females	
	Estimated Coefficients	Standard Error	Estimated Coefficients	Standard Error
NATIVE	0.010	0.013	0.023	0.013 *
AGE3039	0.068	0.015 ***	0.008	0.014
AGE4049	0.087	0.016 ***	0.059	0.015 ***
AGE5059	0.088	0.017 ***	0.097	0.016 ***
AGE6070	0.070	0.021 ***	0.069	0.018 ***
SINGLE	-0.022	0.012 *	-0.042	0.013 ***
WIDDIV	-0.045	0.018 **	0.002	0.012
PRIMED	0.025	0.013 *	0.040	0.013 ***
SECED	0.026	0.009 ***	0.026	0.010 ***
PTWORK	-0.028	0.020	-0.032	0.017 *
UNEM	0.009	0.018	-0.008	0.014
RETIRE	0.007	0.015	0.027	0.014 *
INACTIVE	-0.047	0.019 **	0.010	0.010
FAMIINC2	0.042	0.014 ***	0.010	0.011
FAMIINC3	0.024	0.015	0.002	0.012
FAMIINC4	0.033	0.016 **	-0.012	0.013
FAMINCM	0.013	0.018	0.005	0.014
FSIZE	-0.005	0.004	0.007	0.004 **
MODACT	-0.012	0.009	0.001	0.009
VIGACT	-0.004	0.010	-0.001	0.010
LNHWALK	-0.001	0.002	-0.003	0.002 *
FRUITS	-0.005	0.014	0.008	0.015
VEGSAL	0.018	0.019	0.001	0.022
JUICE	0.004	0.009	-0.015	0.007 **
SMOKE	-0.020	0.008 **	-0.031	0.008 ***
EXCDRINK	0.010	0.009	0.013	0.013
HEALTHCON	0.009	0.011	0.045	0.009 ***
ANXIETY	0.013	0.022	-0.004	0.015
DEPRESS	-0.044	0.040	0.010	0.022
DISABLE	0.040	0.014 ***	0.046	0.010 ***
REGBMI	0.014	0.008 *	0.007	0.007
URBAN	0.015	0.011	-0.016	0.009 *
SEMIURB	0.009	0.014	-0.022	0.013
Constant	3.095	0.062 ***	3.079	0.052 ***
R^2	0.171		0.277	
Joint test: Regional dummies	1.60 *		1.22	
Observations	1621		2427	

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).
Notes: Heteroskedasticity robust standard errors were presented.
Models were weighted using sampling weights.
Thirteen regional dummies (NUTS 2 level) were also included in the models.
Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

Table 7. Marginal effects for the Ordered Probit Model on the probability of normal weight, overweight and obesity

	Males			Females		
Variable	Normal	Overweight	Obese	Normal	Overweight	Obese
NATIVE	-0.064	0.027	0.037	-0.083 **	0.045 **	0.037 **
AGE3039	-0.167 ***	0.036 ***	0.131 ***	-0.016	0.008	0.008
AGE4049	-0.212 ***	0.036 ***	0.176 ***	-0.155 ***	0.069 ***	0.086 ***
AGE5059	-0.234 ***	0.028 **	0.206 ***	-0.253 ***	0.095 ***	0.158 ***
AGE6070	-0.208 ***	0.029 **	0.180 ***	-0.172 ***	0.072 ***	0.099 **
SINGLE	0.085 **	-0.034 *	-0.051 **	0.119 ***	-0.066 **	-0.053 ***
WIDDIV	0.199 ***	-0.107 **	-0.092 ***	0.005	-0.002	-0.002
PRIMED	-0.063 *	0.019 *	0.043	-0.125 ***	0.057 ***	0.067 ***
SECED	-0.076 ***	0.028 **	0.049 **	-0.083 ***	0.042 ***	0.041 **
PTWORK	0.029	-0.011	-0.017	0.041	-0.022	-0.019
UNEM	-0.011	0.004	0.007	0.034	-0.018	-0.016
RETIRE	-0.010	0.004	0.007	-0.104 **	0.047 ***	0.057 **
INACTIVE	0.157 **	-0.077 **	-0.079 ***	-0.054 *	0.027 *	0.027 *
FAMIINC2	-0.091 **	0.026 **	0.065 **	-0.068 *	0.033 **	0.035 *
FAMIINC3	-0.061	0.020	0.041	-0.047	0.023	0.024
FAMIINC4	-0.092 **	0.029 **	0.063 *	-0.001	0.000	0.000
FAMINCM	-0.054	0.016	0.038	-0.033	0.016	0.017
FSIZE	0.025 **	-0.009 *	-0.016 **	-0.017	0.009	0.008
MODACT	0.048	-0.018	-0.030 *	0.007	-0.003	-0.003
VIGACT	0.040	-0.015	-0.025	0.019	-0.010	-0.009
LNHWALK	-0.004	0.001	0.002	0.009 *	-0.005 *	-0.005 *
FRUITS	0.024	-0.008	-0.016	0.003	-0.001	-0.001
VEGSAL	-0.098	0.045	0.053	0.039	-0.019	-0.020
JUICE	-0.027	0.010	0.017	0.049 **	-0.025 **	-0.025 **
SMOKE	0.023	-0.008	-0.015	0.074 ***	-0.038 ***	-0.035***
EXCDRINK	-0.024	0.008	0.016	0.003	-0.001	-0.001
HEALTHCON	-0.012	0.004	0.008	-0.119 ***	0.058 ***	0.061 ***
ANXIETY	-0.023	0.008	0.015	0.009	-0.005	-0.004
DEPRESS	0.069	-0.030	-0.039	-0.030	0.015	0.016
DISABLE	-0.081 **	0.023 **	0.058 **	-0.120 ***	0.055 ***	0.065 ***
REGBMI	-0.025	0.009	0.016	-0.039 *	0.020 *	0.019 *
URBAN	-0.031	0.011	0.020	0.059 **	-0.030 **	-0.029 **
SEMIURB	-0.021	0.007	0.014	0.065	-0.035	-0.030
Wald test (Ho: Cut1=Cut2)		811.06 ***			750.25 ***	
Obs.		1621			2427	

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).

Notes: Heteroskedasticity robust standard errors were presented.

Models were weighted using sampling weights.

Thirteen regional dummies (NUTS 2 level) were also included in the models.

Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

Table 8. Quantile regressions of ln(BMI) for males

	ln(BMI) distribution				
Estimated Coefficients	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
NATIVE	-0.023	0.040 **	0.023	0.012	0.016
AGE3039	0.116 ***	0.095 ***	0.066 ***	0.040 *	0.035
AGE4049	0.121 ***	0.126 ***	0.070 ***	0.063 **	0.072 **
AGE5059	0.133 ***	0.150 ***	0.082 ***	0.058 **	0.054
AGE6070	0.124 ***	0.131 ***	0.051 *	0.059 *	-0.010
SINGLE	-0.030	-0.037 **	-0.031 **	-0.020	0.013
WIDDIV	0.016	-0.059 *	-0.052 **	-0.054 **	-0.063
PRIMED	0.004	0.000	0.032 **	0.029	0.065 *
SECED	0.007	0.019	0.022 *	0.051 ***	0.042 **
PTWORK	-0.030	-0.040	0.008	-0.022	-0.044
UNEM	-0.054	0.000	0.018	0.042	0.041
RETIRE	-0.008	-0.004	0.004	0.004	0.085 *
INACTIVE	-0.055	-0.035	-0.035 *	-0.019	-0.087 ***
FAMIINC2	0.064 **	0.057 ***	0.038 **	0.039 *	0.060 *
FAMIINC3	0.040	0.027	0.025	0.014	0.040
FAMIINC4	0.049	0.039 *	0.036 **	0.020	0.041
FAMINCM	0.013	0.013	0.015	-0.005	0.029
FSIZE	-0.014 **	-0.014 **	-0.006	0.004	0.006
MODACT	-0.008	-0.014	-0.010	-0.026 *	-0.008
VIGACT	0.019	-0.002	-0.005	-0.023	0.003
LNHWALK	-0.003	0.000	-0.002	0.002	-0.004
FRUITS	0.009	0.000	0.001	0.002	-0.033
VEGSAL	-0.039	0.027	0.020	0.023	0.020
JUICE	-0.007	0.000	-0.008	0.022	0.017
SMOKE	-0.058 ***	-0.010	-0.022 **	-0.011	-0.007
EXCDRINK	0.033 *	0.016	0.010	0.017	-0.011
HEALTHCON	-0.008	0.007	0.005	0.003	0.014
ANXIETY	0.050 *	0.033	0.032	-0.025	-0.003
DEPRESS	-0.032	-0.076	-0.035	0.006	-0.050
DISABLE	0.018	0.001	0.028 *	0.062 ***	0.092 **
REGBMI	-0.011	-0.008	0.012	0.042 ***	0.046 **
URBAN	0.036 **	0.022	0.014	0.010	0.035
SEMIURB	0.025	-0.004	0.005	0.016	0.023
Constant	3.166 ***	3.074 ***	3.096 ***	2.992 ***	3.033 ***
Pseudo R^2	0.124	0.165	0.121	0.085	0.063
Joint test: Regional dummies	0.88	0.89	0.87	0.50	0.45
Observations			1621		

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).
Notes: Bootstrapped standard errors (1000 replications) are not presented for the sake of brevity.
Estimations were weighted using sampling weights.
Thirteen regional dummies (NUTS 2 level) were also included in the models.
Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

Table 9. Quantile regressions of ln(BMI) for females

	ln(BMI) distribution				
Estimated Coefficients	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
NATIVE	0.016	0.029	0.033 *	0.017	-0.007
AGE3039	0.035	0.018	-0.003	-0.017	0.020
AGE4049	0.092 ***	0.098 ***	0.068 ***	0.017	0.032
AGE5059	0.098 ***	0.125 ***	0.118 ***	0.084 ***	0.062 **
AGE6070	0.101 ***	0.110 ***	0.105 ***	0.043	0.007
SINGLE	-0.050 *	-0.049 **	-0.043 **	-0.051 ***	-0.036 **
WIDDIV	-0.001	-0.006	-0.004	-0.003	0.039
PRIMED	0.015	0.039 **	0.054 ***	0.067 ***	0.009
SECED	0.017	0.034 **	0.027 *	0.034 **	0.008
PTWORK	-0.080 **	-0.050 *	-0.031	-0.026	-0.009
UNEM	-0.026	0.008	-0.012	-0.021	0.004
RETIRE	-0.009	0.029 **	0.031 *	0.018	0.032
INACTIVE	-0.004	0.018	0.021	-0.007	0.013
FAMIINC2	-0.032 *	-0.010	0.022	0.030	0.022
FAMIINC3	-0.011	-0.007	0.025	-0.006	-0.003
FAMIINC4	-0.016	-0.031	-0.005	-0.011	-0.013
FAMINCM	-0.012	-0.002	0.018	0.004	-0.006
FSIZE	0.006	0.013 ***	0.008	0.004	0.007
MODACT	0.000	0.006	-0.002	-0.004	0.009
VIGACT	-0.005	0.006	-0.001	0.002	-0.014
LNHWALK	0.002	-0.002	-0.004	-0.005 *	-0.005
FRUITS	0.022	0.002	0.002	0.009	0.001
VEGSAL	0.036	0.005	-0.011	-0.003	-0.006
JUICE	0.006	-0.016	-0.018 *	-0.020	-0.028 *
SMOKE	-0.025 **	-0.038 ***	-0.042 ***	-0.038 ***	-0.003
EXCDRINK	0.038	0.035	0.001	0.020	0.011
HEALTHCON	0.026 **	0.029 ***	0.036 ***	0.071 ***	0.078 ***
ANXIETY	0.013	-0.004	-0.009	-0.010	-0.047
DEPRESS	-0.015	-0.012	0.013	0.034	0.048
DISABLE	0.016 *	0.025 **	0.052 ***	0.061 ***	0.066 ***
REGBMI	-0.003	-0.003	0.007	0.033 ***	0.009
URBAN	-0.010	-0.013	-0.024 **	-0.020	-0.011
SEMIURB	-0.015	-0.005	-0.030	-0.039 *	-0.010
Constant	2.899 ***	2.964 ***	3.041 ***	3.095 ***	3.371 ***
Pseudo R^2	0.127	0.200	0.226	0.165	0.090
Joint test: Regional dummies	1.59 *	0.74	0.73	0.72	1.21
Observations			2427		

Source: National Health Survey, Greece, 2009, Hellenic Statistical Authority (EL.STAT).
Notes: Bootstrapped standard errors (1000 replications) are not presented for the sake of brevity.
Estimations were weighted using sampling weights.
Thirteen regional dummies (NUTS 2 level) were also included in the models.
Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.