Economic Growth and Obesity:
Findings of an Obesity Kuznets Curve

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Abstract

Simon Kuznets' (1955) hypothesis that as a country develops, a natural cycle develops where inequality first increases, then decreases, has become known at the Kuznets curve. This pattern has also been applied to the environment, an 'Environmental Kuznets curve', showing that as development occurs, pollution first increase; then decreases because people value clean air. We expand the Kuznets curve to an 'Obesity Kuznets curve'; as incomes rise, resources become available to buy more food. As such, people consume more calories and obesity rates increase. However, as incomes continue to rise, personal health becomes a more valued asset and people decrease their obesity levels (increasing their health levels). We find evidence of an Obesity Kuznets curve for white females. In addition we find that as income inequality increases obesity rates fall.

JEL: I1, D1
Key Words: Obesity, Kutznets Curve, Body Mass Index, Health Outcomes

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I. Introduction

The Kuznets curve (Simon Kuznets 1955), was first used to describe the progression of economic inequality as countries develop. It describes the finding that inequality first increases and then decreases. Subsequently, the Kuznets curve has been applied to the evolution of pollution levels of countries through their development process. The 'Environmental Kuznets curve', as was popularized in Grossman and Krueger (1995) and the World Bank (1992), hypothesizes that as countries develop, they produce more pollution at first, then decrease their pollution levels as incomes continue to rise.

We continue the expansion of the applications of the Kuznets curve to personal health, as proxied by obesity. As incomes rise, weight gain occurs because individuals can now afford excess food, food beyond the minimal subsistence level. Caloric imbalance eventually leads to an increase in obesity rates (Koplan and Dietz 1999). However, if health is a normal good, as incomes continue to rise people are able to shift their consumption to healthier foods to increase the health levels. As this occurs, and as people invest more in their overall personal health, obesity rates decline, creating an Obesity Kuznets curve.

The next section looks at the connections between income and health outcomes. For this purpose, we use data from the Behavioral Risk Factor Surveillance System (BRFSS) and Current Population Survey (CPS) March Supplement, described in section three. We find that data pertaining to white females provide clear evidence of an Obesity Kuznets curve but the white males data do not, which is to be expected as explained below. The model and results are discussed in section four followed by the conclusion with policy implications.

II. Health and Income

The leisure/labor tradeoff has major implications to health outcomes. Increased leisure time allows for more time to exercise and prepare healthier meals. However, an increase in labor allows, implicitly, a higher income to afford healthier foods. These conflicting effects have led to a large literature on the impact of income on health.

A wide body of literature suggests there is a positive relationship between income and health (Smith 1999), within and between countries (Marmot 1999) and across ages (Case et al 2002). In addition, macroeconomic conditions, specifically economic cycles, have been used to explain health outcomes. Ruhm (2000) finds that economic recessions, as measured by unemployment rates, are healthy for the population because both smoking and obesity increase when the economy strengthens, whereas physical activity increases and diets are healthier when the economy weakens (because people have more time).[2] However, in a later study (Ruhm 2013), these results are found to be unstable over different time periods and any found relationship is not consistent across causes of death.[3] Perhaps more closely related to our paper Charles and DeCicca (2008) found that obesity rates among men are procyclical, they increase as macroeconomic conditions, as proxied by unemployment rates, worsen.

Thus, previous studies found mixed results when linking income and health. We extend this literature by analyzing the link between income and obesity. Specifically we find evidence of an 'Obesity Kuznets curve.' We find that obesity first increases as incomes rise. As people first get out of poverty, their higher incomes allow them to increase their caloric intake, either by increasing in the amount of food or the density of the food consumed. It is also possible that as

[2] This procyclical result has been supported using data from Germany (Neumayer 2004), Spain (Tapia Granados 2005), Mexico (Gonzalez and Quast 2011), Canada (Ariizumi and Schirle 2012), OECD countries (Gerdtham and Ruhm 2006), and Pacific-Asian nations (Lin 2009).

[3] The findings of no relationship, or a positive relationship, to economic cycles are found in: McInerney and Mellor (2012) and Svensson (2007).

their incomes rise they exercise less, traveling by car instead of walking or taking a sedentary job rather than being active throughout the day. However, as incomes rise above a certain level, their ability to purchase, and consume, healthier food, and possibly their ability to increase physical activities, increase their healthiness; thus, decreasing their obesity levels.

We find that obesity rates peak at $29,744 (in 2010 dollars) in total pre-tax income (or losses) from all sources for white females. Given that obesity is the second leading cause of preventable death in the United States (National Heart, Lung, and Blood Institute 1998), these findings have major implications for the outcomes of policies directed to influence incomes and health. The findings of an Obesity Kuznets curve can also explain differences among various estimates of the impacts of a recession, because the impact of a recession would depend on which section of the curve the person was on.

This relationship with income/wealth and weight has been studied by Sobal and Stunkard (1989), Mendez et al. (2005), McLaren (2007), and Hruschka and Brewis (2013). Hruschka and Brewis (2013) find rising rates of overweight women, aged 18-40 and non-pregnant, in lower and middle income countries closely track increasing economic resources. Mendez et al. (2005) find that being overweight is more prevalent than underweight in women. Sobal and Stunkard (1989) suggest that higher SES men and women are more likely to be overweight in developing countries. However, as a countries income increases, these results flatten and can reverse; giving the first suggestion of an Obesity Kuznets curve. We further these studies by finding evidence of an Obesity Kuznets curve (both Sobal and Stunkard, 1989 and McLaren, 2007 provide reviews of the extant literature on these topics).

III. Data

To accurately identify the Obesity Kuznets curve we use a state level panel from 1991-2010. We use the body mass index (BMI) data from the BRFSS to obtain the average BMI levels and the proportion of state population that is obese (BMI≥30) and morbidly obese (BMI≥40).[4] The data are further divided by gender, age, and race to separate out any differences in obesity levels that vary by demographic groups.[5] Thus the unit of observation is a state/year/demographic group cell. The obesity rates of black Americans are higher, they may face different social pressures, and the obesity rates data for black American groups are noisy;[6] thus, we focus on the sample of white Americans. Given that women face more social pressures in terms of obesity, we expect obesity rates to peak at lower incomes in the case of women than in the case of men and present summary statistics for the white population by gender in Table 1.

Table 1: Summary statistics

	Obs	Mean	Std. Dev.	Min	Max
Female:					
Average BMI	4044	25.69	1.48	21.05	29.23
Obese (BMI>=30)	4044	19.05	7.20	0	39.39
Morbidly obese (BMI>=40)	4044	2.82	1.76	0	10.97
Male:					
Average BMI	4044	27.02	1.30	22.77	30.11
Obese (BMI>=30)	4044	19.77	8.48	0	42.05
Morbidly obese (BMI>=40)	4044	1.64	1.45	0	12.03

The state level data on income by demographic group comes from the CPS March Supplement. This long series of data covers both recessionary periods and expansions, thus,

[4] We have an unbalanced panel of data because during the early period not all states conducted surveillance. These missing values are quite few and our data is representative for the country as a whole. BMI is defined as the weight, in kilograms, divided by height, in meters squared. The BRFSS lists incomes in brackets, which is not suitable for this study. Thus, we use income data from CPS.

[5] Age groups: 18-24 - omitted; 25-34; 35-49; 50-64. Race groups: White and Black.

[6] See figures 1 and 2 in the Appendix [not for publication]. We find no evidence of an Obesity Kuznets curve for this group.

providing significant variation on income. Based on the same data we also obtain the state-level Gini coefficient for each year. This is a standard measure of income inequality, which ranges from 0, perfect equality, to 1, perfect inequality, to control for differing levels of income inequality across demographic group.

Data for the other controls, each demographic group' education, marital status, and unemployment rate (following Ruhm 2013) also comes from the CPS March Supplement. The source of the annual state level population data by demographic group is the National Center for Health Statistics Bridged-race intercensal estimates.

IV. Empirical Strategy and Results

We use a differences-in-differences strategy to estimate the relationship between income and obesity rates. We estimate the following equation for state *s*, demographic group *d*, at time *t*, separately for white females and white males:

$$Obesity(Overweight)\ Prevalence_{sdt} = \beta_1\ Income_{sdt} + \beta_2\ (Income_{sdt})^2 + X'\delta + \gamma_s + \tau_t + \varepsilon_{sdt}$$

We focus on the effect of the income, β_1 and β_2. X is a vector of time-varying determinants of health outcomes: income inequality, as measured by the Gini coefficient, education, marital status, and unemployment rate.[7]

By including state fixed effects, γ_s, this specification controls for differences in obesity rates that are common to people in the same state (for instance, differences in the overall level of health due to climatic conditions or unmeasured cultural factors). Year fixed effects, τ_t, absorb

[7] We control for income inequality, using the gini coefficient, following a line a literature that debates the impact of inequality on health outcomes: Preston (1975) claims that the redistribution from rich to poor will improve health outcomes, either within a given country or across countries. In fact, Lynch et al. (1998) take this so far as to say the impact of income inequality "exceeds the combined loss of life from lung cancer, diabetes, motor vehicle crashes, HIV infection, suicide, and homicide in 1995" (pg. 1079). However, other studies have found no evidence of income inequality impacting health outcomes. Judge, Mulligan, and Benzeval (1998) find an insignificant link between the gini coefficient and life expectancy. Also, Deaton (2003) finds no direct effect of inequality. Finding that it is the absolute amount of wealth that increases health outcomes, not the relative wealth considered in inequality measures. Education groups: percent with less than a high-school education - omitted, a high-school education, with some college, and with a college education or more. Marital status: percent married.

any time-varying differences in the dependent variable common to all states, such as changes in federal level policies (these results are robust to age specific time effects).

Females are more likely to be socially punished, relative to males, for being overweight (Cawley 2004). Because we expect stronger effects in the case of women, we first look at white females. Column one uses the average BMI level as the dependent variable and columns two and three look at the percent obese or morbidly obese, respectively, as the dependent variable; presented in Table 2. We find a positive and significant coefficient on income, and a negative and significant coefficient on income squared.

Table 2: Measures of an Obesity Kuznets curve, Female

	(1)	(2)	(3)
VARIABLES	White Female BMI	White Female BMI>=30	White Female BMI>=40
Income, $10000	0.158	2.088***	0.976***
	(0.152)	(0.741)	(0.351)
Income squared	-0.052**	-0.351***	-0.134**
	(0.024)	(0.114)	(0.052)
Gini Coefficient	-2.116***	-12.889**	-3.363
	(0.760)	(4.958)	(2.276)
Unemployment rate	-0.003	0.032	0.025
	(0.012)	(0.069)	(0.036)
Constant	23.959***	6.173*	-1.549
	(0.391)	(3.649)	(1.580)
Observations	4,044	4,044	4,044
R-squared	0.917	0.858	0.643

Robust standard errors in parentheses. Other controls included, but not reported: State Fixed Effects, Yearly Fixed Effects, % Married, Educational Categories, and Age Categories
*** p<0.01, ** p<0.05, * p<0.1

Our results suggest that average BMI is increasing with income at a decreasing rate. These income variables are jointly significant and peak at an income of $15,192. When looking at the percent obese (BMI≥30), income is increasing at a decreasing rate, creating an Obesity Kuznets curve that peaks at $29,744. We find that the Kuznets curve for morbidly obese (BMI≥40) white females peaks at $36,418.

Men face a different, or possibly no, social pressure for being overweight. Thus, in table 3 we use the sample of white males to investigate how their obesity rates relate to income. The first column uses the average BMI level as the dependent variable and columns two and three look at the percent obese or morbidly obese, respectively, as the dependent variable.[8]

Table 3: Measures of an Obesity Kuznets curve, Male

	(1)	(2)	(3)
VARIABLES	White Male BMI	White Male BMI>=30	White Male BMI>=40
Income, $10000	0.016	0.630	-0.108
	(0.070)	(0.491)	(0.144)
Income squared	-0.001	-0.032	0.007
	(0.005)	(0.036)	(0.010)
Gini Coefficient	-2.062***	-20.785***	-3.948**
	(0.606)	(6.225)	(1.562)
Unemployment rate	0.011	0.154*	0.032
	(0.011)	(0.077)	(0.032)
Constant	24.896***	13.780***	1.262
	(0.383)	(3.841)	(1.196)
Observations	4,044	4,044	4,044
R-squared	0.904	0.838	0.513

Robust standard errors in parentheses. Other controls included, but not reported: State Fixed Effects, Yearly Fixed Effects, % Married, Educational Categories, and Age Categories
*** p<0.01, ** p<0.05, * p<0.1

As expected, given that males face no social pressures for weight, we find no statistically significant evidence of a Kuznetz curve. For both males and females we find that, in general, obesity increases with age and education. These results are robust to controlling for state specific trends. These results are consistent with and without an income inequality control (the Gini coefficient). The Gini coefficient is negative and significant for BMI and percent obese for both females and males. Thus less equal societies decrease the amount of obesity within those categories.

V. Conclusion

[8] It is possible that obesity impacts wages and wages impact obesity (traits that cause one to be healthy, delayed gratification, self-control, etc., are also traits that increase one's health). Thus we measure both leads and lags on income with similar results. Controls are not reported for brevity. Please contact the authors for these results.

Using data from the United States we find evidence of an Obesity Kuznets curve for white females. Our results suggest that obesity increases with incomes, to a point. Then obesity decreases with a continued increase in income with a peak of this curvilinear relationship is at $29,744 in total pre-tax income. This result does not hold for white males, possibly because females are more likely to be socially punished for obesity. We also find that as income inequality increases, obesity rates fall. This is an interesting finding given the mixed literature on the topic and should be considered for future research.

Whether income is the driving factor behind obesity or not, the policy implications of these finds are important. First, when obesity is driven by income, fighting obesity can occur by increasing wage opportunities for these individuals as well as direct policies fighting obesity. Also, agricultural policies that impact the price of food increase obesity levels as people push through the Obesity Kuznets curve. Second, given that males and females have different outcomes, the policies need to take these differences into account.

The reader should note that an increase in obesity is not necessarily associated with a decrease in life expectancy when economic development increases the marginal impact of medical care. One contribution of this study is to provide a framework in which to analyze and understand the evolution of the intermediary measures of health, such as obesity. In particular, economic development likely changes the relative prices of various inputs in health production leading to changes in the prevalence of various intermediary measures of health output. Such changes, however, can still be consistent with the observed long-term increase in life expectancy.

Given the findings of an increased obesity rate in the United Sates (see Rashad, Grossman, and Chou 2006), this could also be a sign of economic progress. Thus, the next step to decreasing obesity rates could be to push through the cycle of the Obesity Kuznets curve.

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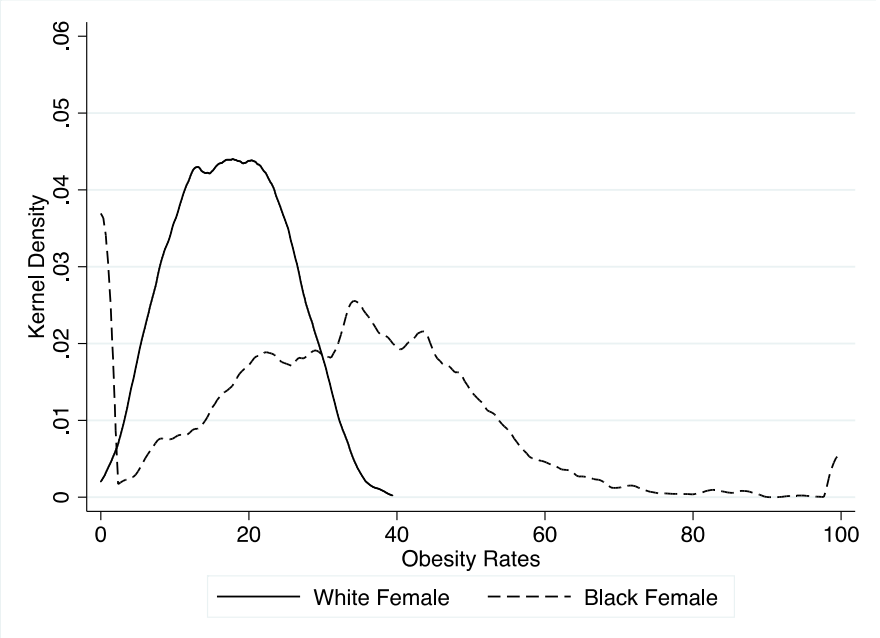
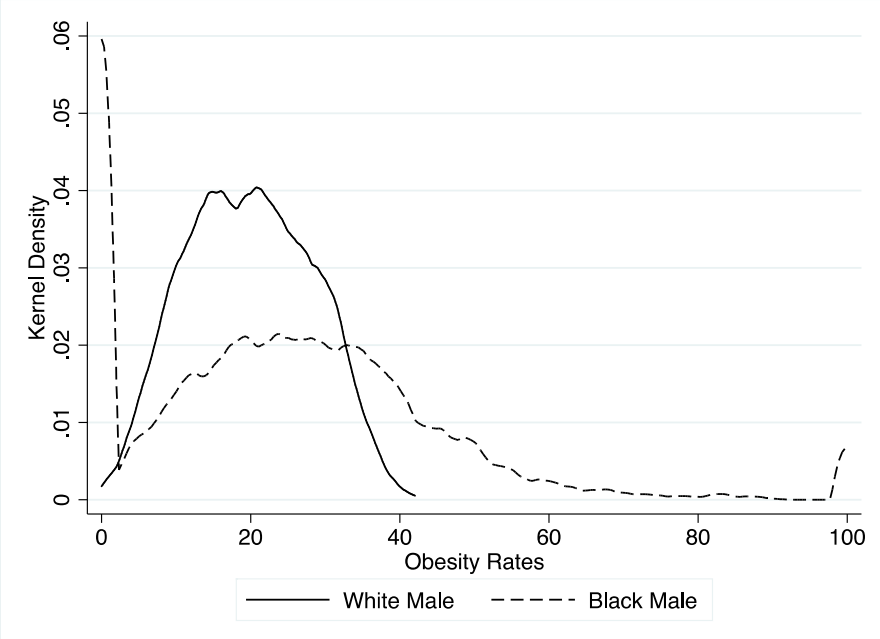
Appendix:
Figure 1. Probability Density Function for Obesity Rates





The kernel density estimate was obtained using an Epanechnikov kernel function with a bandwidth of 1.