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Economic origins of dietary diseases: Is Obesity becoming a middle income problem?

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Abstract

Obesity resembles a typical negative economic externality to the public health system. Previous literature identifies a positive connection between national income levels and incidence of obesity. Due to changes in globalization of food culture and media, food habits are spreading rapidly over the country borders from high into middle income countries. Due to these developments, association of obesity with high income is questionable. We pursue this research question using cross-country data from 2013 by modeling obesity-related dietary health outcomes in terms of linear and nonlinear income effects. Additional control variables include within-country income inequality and region fixed effects. Departing from the linear trends in the literature, the model results show statistically significant nonlinear effects of income. However, these effects are small in magnitude.

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Keywords: Dietary diseases; Income effect; nonlinearity; cross-sectional study

1. Introduction

Obesityis becoming a pandemic that plagues countries of different income levels[1]. Historically, obesity was associated with high income but the relationship is fast evolving due to globalization of food culture and mass media connected to food industry[2]. Recent literature attempts to pin down the relationship between income level and obesity. Egger and coauthorsshow that Goss Domestic Product (GDP), the standard measure

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of country income level, is positively related to Body Mass Index (BMI) up to approximately USD 3000 per capita, with no significant relationshipbeyond this level[3]. Neumann and coauthors find a positive but non-significant association of GDP and mean BMI using national survey data from 38 countries[4]. What is topical about the connection between income and obesity is that it is potentially influenced by other socio-economic variables and, as such, linear relationships may not exist. We perform an analysis that enables testing an existence of a non-linear relationship.In the same spirit as the famous (environment) Kuznet's curve relationship between pollution and income, our general hypothesis is that current incidence of obesity peaks in middle income range.

In this paper, weestimate the relationship between national income and dietary disease incidence related to obesity using cross-country data from the year 2012/2013. Based on the data availability, we use a sample of 75 countries representative of all regions of the world.

2. Methodology

We estimate a regression specification with a non-linear term for national income level to explain several outcome variables representing dietary diseaseconditionsassociated with obesity. The generic specification is outlined in equation (1) below. The four models use the rate of overweight (Body Mass Index 25-30 kg/m^2), rate of obesity (BMI above 30 kg/m^2), rate of high (clinical) blood glucose (i.e. Diabetes), rate of high (clinical) blood pressure (i.e. Hypertension) respectively as outcome variables. We use WHO guidelines for incidence of clinical levels of glucose and pressure.

$$DietD = \beta_1 + \beta_2 GDP + \beta_3 GDP^2 + \beta_k regionFE + \beta_l Gini + \varepsilon \qquad (1)$$

Where,

DietD:	Dietary Diseaseindicator (overweight / obesity / blood glucose / blood pressure)
GDP:	level of national income (measured by Gross Domestic Product, 2012)
Gini:	income inequality index
regionFE:	fixed effects of geographical region (identifying, Asia, Africa, Europe, North America, Latin America, Oceania)

The comparative statics of this specification yields the following partial effect for income, which is what we are interested in. Thus, the partial or marginal effect of income in this model is dependent on the level of GDP.

$$\partial DietD/\partial GDP = \beta_2 + 2\beta_3 GDP$$

Holding GDP at different levels of the distribution, we are able to calculate the marginal effect of income on each dietary disease indicator. This calculation provides evidence of nonlinearity of income effect if it exists in the data.

The above specification (equation 1) is estimated using data from 75 countries and heteroskedasticity corrected standard errors are calculated in order to determine the statistical significance of each parameter.

3. Results, discussion, conclusion and recommendations

The results of the two models are listed in Table1. From left to right (columns numbered 1 to 4), overweight rate, obesity rate, diabetes and hypertension incidence is modeled in terms of income and other covariates. The linear term and the nonlinear term of income provide evidence to validate the hypothesized 'inverted U shaped' relationship.

Given that different regions of the world typically represent different food habits as well as health conditions, we have explicitly included the region fixed effects into the estimation. As an additional covariate that controls for the heterogeneity of economic conditions, we have included Gini index of income inequality.

Considering the limited number of predictors, we obtain a relatively substantial explanatory power as evident in the R squared values of model fit in all the four models. However, the magnitude of income effects is rather small compared to what is generally anticipated. As a result, the nonlinearity (i.e. as in Environmental Kuznet's curve) is less pronounced in the range of actual GDP values. However, reversal of the sign is statistically significant indicating that rates of overweight and obesity peak in the mid income range. Analysis of Diabetes and Hypertension incidence does not provide conclusive evidence. In fact, hypertension rates show a statistically significant decline as income levels increase. Based on the relatively low model fit, explanation of diabetes incidence is likely to be misspecified. That is, variables other than income may explain occurrence of diabetes.

We conclude that even though income level is just one significant predictor of cross country variation of obesity related dietary disorders, it appears to explain a substantial portion of the variation in the incidence rates. Further, an inverted U shaped relationship between income and obesity is observable based on the statistical significance and the sign of the parameter. However, the magnitudes are too small to emerge clearly in small samples. It is likely that as food habits, culture and advertising become more globalized, the expected nonlinearity may be clearer in future cross sectional data.

In terms of policy recommendations, the findings have short term and long term implications to public health decisions. In the short term, low and middle income countries have to make provisions in the healthcare budgets for obesity related illnesses. However, given the marginal increase in rates, countries with smaller populations do not have to anticipate a large burden.

Table 1.Linear and nonlinear income effects and dietary disease incidence

	(1) Overweight	(2) Obesity	(3) Diabetes	(4) Hypertension
GDP	0.00127***	0.00066***	0.00003	-0.00025***
	(0.00036)	(0.00021)	(0.00006)	(0.00008)
GDP^2	-0.00001***	-0.00001**	-0.00000	0.00000
	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Gini-index	0.05496	0.00572	-0.02806	0.08194
	(0.29280)	(0.17638)	(0.03548)	(0.06078)
Region Fixed Effects:				
Asia	-1.70052	-1.33664	0.86047	-4.80221***
	(6.39682)	(3.59032)	(0.92864)	(1.41200)
Europe	5.34305	0.71883	-0.80621	2.43341
	(7.38675)	(4.39423)	(1.17463)	(1.78018)
Latin America	15.20505***	6.81718**	1.02199	-5.61441***
	(5.28453)	(3.28504)	(0.93216)	(1.12287)
North America	8.54803	3.96754	0.96646	-7.51862***
	(8.95002)	(5.74516)	(1.54517)	(1.98623)
Oceania	44.62644***	30.91608***	8.46182***	-5.64959***
	(6.21358)	(3.84152)	(0.80835)	(0.99488)
Constant	24.59165*	8.54359	10.16875***	43.30296***
	(13.24105)	(7.76889)	(1.53330)	(2.98650)
Observations	75	75	75	75
Log likelihood	-2.9e+02	-2.5e+02	-1.5e+02	-1.9e+02
R squared	0.53201	0.46259	0.26002	0.58293

Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

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