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ALSO IN THIS ISSUE

The Conflicting Effect of Obesity and Undernourishment on Average Life Expectancy

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There is a growing concern regarding the health effects of increasing global obesity rates, and micro-level studies demonstrate that obesity reduces life expectancy. We conducted a macro study at the country level relating average life expectancy with obesity rates and other factors. Our analysis suggests that increased obesity prevalence may increase life expectancy when obesity rates are low and malnutrition is significant. Our results also suggest that higher obesity rates increase life expectancy in developing countries, but reduce life expectancy in some developed countries, such as the U.S., which suffer from high obesity rates.

Historically, societies were concerned about undernourishment, hunger, and starvation amongst populations. The severe prevalence of undernutrition in many countries of the world led to research and policy focus on malnutrition. Nations and international organizations directed efforts towards providing more calories and alleviating hunger. In the last 50–60 years, however, obesity prevalence has emerged as a new health hazard.

Obesity has reached epidemic proportions globally, with more than 1.9 billion adults estimated to be overweight and at least 650 million of them qualifying as being obese. For an individual, overweight and obesity are associated with a higher risk of non-communicable diseases such as diabetes and hypertension. World Health Organization (WHO) (2018) reports that at least 2.8 million people die each year as a result of being overweight or obese. The rising overweight and obesity prevalence imposes a heavy burden on countries. Once associated with high-income countries, overweight and obesity have reached the low- and middle-income countries. WHO estimates of age-standardized obesity prevalence indicate a rise in obesity prevalence for almost every country in the world during the past two decades.

Table 1 presents overweight and obesity prevalence, and its percentage change, among select high-income and low- and middle- (L&M) income countries between 2005 and 2015. For many low- and middle-income countries, the percentage increase in the overweight and obesity prevalence has been well above 30%, which is alarming. The global attention now is on mitigating obesity prevalence. Countries are worried that rising obesity levels could impose substantial health and financial burdens. Concerns about obesity have led to policies such as sugar, fat, and soda taxes that aim at reducing the consumption of calories. There are also regulations aiming to limit the sugar content of processed foods and drinks.

An individual is classified as underweight, overweight, obese, or normal weight according to Body Mass Index (BMI), which is defined as an individual's weight in kilograms divided by the square of his height in meters. As per WHO classification, a person is obese if BMI is greater than 30, overweight if BMI is between 25–30, in the normal weight category if BMI is in the range of 18.5–25, and underweight if BMI is below 18.5. The classification is the same for men and women.

Micro vs. Macro Studies of the Impact of Obesity

Most of the literature on obesity consists of "micro" studies that look at individual-level data to estimate the impacts

Table 1. Overweight and Obesity Prevalence (in Percentage) for the Years 2005 and 2015

Country	Percentage Overweight or Obese (2005)	Percentage Overweight or Obese (2015)	Percent Increase in Overweight or Obesity	Projected Values for Year 2025
L&M Income Countries				
Bangladesh	13.8	19.4	40.6	27.3
India	14.2	19.1	34.5	25.7
Nepal	15.0	20.4	36.0	27.7
Sri Lanka	16.8	22.6	34.5	30.4
Myanmar	17.5	24.0	37.1	32.9
Bhutan	19.1	26.4	38.2	36.5
Pakistan	21.1	27.7	31.3	36.4
China	24.1	31.6	31.1	41.4
High-Income Countries				
Hungary	55.8	61.1	9.5	66.9
UK	57.8	63.2	9.3	69.1
Canada	58.6	63.7	8.7	69.2
Mexico	58.9	64.4	9.3	70.4
Australia	59.2	64.0	8.1	69.2
United States	61.9	67.4	8.9	73.4

of various factors, including BMI, on indicators of health, including longevity. Some studies have found that severe obesity in the U.S. may reduce the life expectancy of males by 0.6 and females by 0.9 years. Broader surveys of the literature that include findings from developing countries also suggest that obesity and even overweight increase mortality risk. There is evidence that increases in obesity result in direct health care costs and indirect costs of lost productivity due to illness. It is estimated that 27% of the rise in inflation-adjusted medical expenditures in the U.S. between 1987 and 2001 was due to the rising prevalence and costs of obesity. A recent study predicts that a one-unit increase in BMI for every adult would increase annual public medical expenditures by $6.0 billion.

Micro studies provide the background for developing guidelines for individual behavior and are essential for the work of medical doctors and nutritionists. But policymakers are also interested in macro findings from analyses of aggregate data, which can assist in identifying factors associated with higher life expectancies across communities, and investigating the relationship between obesity and life expectancy in different communities.

Aggregate analysis is also useful for comparison among regions and nations and for assessing broad policy proposals. For example, there are recent proposals to reduce obesity across the board (by sugar or soda taxes), based on micro analyses that emphasize the negative effects of obesity. An important question is: to what extent will such policies that aim to reduce obesity prevalence improve average measures of health of different populations?

This question led us to conduct a macro analysis of the impact of an aggregate measure of obesity (percentage obese in a region), as well as other factors, on aggregate life expectancy. Because the population is comprised of several groups of individuals—underweight, healthy, and obese—and the sum of probabilities is equal to 1, populations with higher shares of obesity are likely to have a relatively smaller underweight population.

Thus, the impact of aggregate obesity on average life expectancy may include both the direct effect of the increase in obesity prevalence and the indirect effect of the decrease in underweight prevalence. Populations with a higher rate of obesity may have a longer average life expectancy if the impacts of the reduced prevalence of underweight individuals on average life expectancy dominate the impacts of the higher obesity rate.

While micro studies clearly suggest that obesity reduces life expectancy (all else equal), the macro relation between average obesity and average life expectancy is not obvious theoretically and needs to be examined with data. Another difference between micro and macro approaches is that micro studies allow one to identify the impacts of individual traits (biological, socioeconomic, habits, etc.) on life expectancy, while macro studies allow one to detect the impacts of variables common to individuals within a community but different between communities (access to education, average medical expenditure, weather, etc.). The fixed factors that affect all or nearly all individuals of a country can be controlled for in a macro study but are not likely to be included in a micro study conducted in a single country. Macro studies provide added perspective on community well-being and impacts of broad policies.

The Econometrics Analysis

Our empirical analysis used data from the WHO and other sources for 183 countries during the period 2007–2014, with information about life expectancy at birth, adult obesity rates, mortality rates for men and women, per capita health expenditures, and GDP at constant prices. Also included were several other indicators, such as school enrollment and climatic conditions in different countries.

Our econometric analysis has several key findings. First, increasing prevalence of obesity is associated with increased average life expectancy for men in countries where obesity rates are below 25% and for women in countries

where obesity prevalence is below 30%. Above these threshold levels, average life expectancy declines with increases in the rate of obesity. The macro results suggest that for many countries—mostly developing ones—underweight has a greater impact than overweight, in the sense that a marginal increase in obesity prevalence will increase average life expectancy of the country.

One implication is that enhancing food intake in developing countries will improve average life expectancy. Of course, obese individuals should take measures to reduce their own weight, and optimal food intake is an individual choice. The analysis suggests establishing bifurcated food policies: expanding nutritional availability and intake for low BMI individuals and, at the same time, promoting habits and incentives that will reduce obesity among high BMI individuals.

A second conclusion is that health expenditure has a positive effect on longevity. In particular, the incremental contribution of increased health expenditures to life expectancy per capita is higher for women, possibly suggesting biased allocations of health expenditures toward men. Thus, health expenditures targeted at women result in greater life expectancy gains.

In high-average obesity countries (e.g., the U.S.), high medical expenditures may counter some of the negative effects of obesity on life expectancy. In developed countries, high medical expenditures may also may offset some of the negative effects of underweight. The incremental effect of an increase in health expenditure is higher in less-obese countries, which tend to be developing countries. Our analysis also suggests an opportunity for economic gains from reducing obesity rates in high-obesity countries since significant expenditures are used to counter the adverse effects of obesity on life expectancy in these countries.

A third conclusion is that global average life expectancy tends to increase over time, by 1 year around every 5 years globally during our study period, 2007–2014. Further, women have a higher life expectancy than men ranging from 3.42 year to 4.84 years on average. Obesity prevalence is higher among women, and they are less adversely affected by obesity. About 1.4 years of difference in life expectancy between females and males is explained by higher average obesity, which tends to increase life expectancy, especially in developing countries.

Our fourth conclusion is that average obesity has increased significantly between 2007–2014. The global average of national rates of obesity among men increased from 11.5% to 14.3%, and for women it increased from 16% to 21.3%. This seems to increase life expectancy, as for most countries it has been associated with a reduction in underweight. Japan, Singapore, and Korea have obesity prevalence lower than 10%; these countries have high life expectancy and relatively low per capita health expenditure. The variance of BMI in these countries is smaller than in other countries, with the lion's share of the population in the "normal BMI region," which contributes to high life expectancy and low medical costs.

Table 2. Average Life Expectancy, Obesity Prevalence, Health Expenditure per Capita for Selected Countries According to Life Expectancy Among Women

Country	Life Expectancy (2016)		Percent Obese (2016)		Expenditure/Capita (2014)
	Women	Men	Women	Men	$
Japan	87.2	81.1	4.1	4.6	3,727
France	85.7	80.1	23	23.5	4,508
Italy	84.9	80.5	23.3	22.5	3,239
UK	83.2	79.7	30.4	28.6	3,377
USA	81.0	76.0	38.2	36.5	9,403
Mexico	79.2	74.0	32.6	23.7	1,122
Brazil	78.9	71.4	25.9	18.5	1,318
China	77.9	75.0	7.1	6.2	731
Russia	77.2	66.4	30.8	19.4	1,836
Saudi Arabia	76.5	73.5	41.2	31	2,466
Egypt	73.0	68.2	40	22	594
Indonesia	71.4	67.3	9	4.9	299
India	70.3	67.4	4.9	2.7	267
Kenya	68.9	64.4	9.4	2.5	169
Ethiopia	67.3	63.7	5.6	1.6	73
South Africa	67.0	60.2	38.5	14.5	1,148
Afghanistan	64.5	61.0	6.2	2.7	167
Ghana	64.4	62.5	15	4.1	145
Nigeria	55.7	54.7	11.5	4.1	217
Cote d'Ivoire	55.7	53.6	13.1	5.2	187

Global and U.S. Cases

Tables 2 and 3 present data for 20 countries and for 20 U.S. states, selected to represent the major patterns that we report here. For each region, we present the 2016 life expectancy and average obesity rates, for men and women, and medical expenditure per capita (based on 2014).

The three countries with the highest life expectancy (1–3 in table 2) have average obesity rates that are smaller than those of the second eight countries (4–11), while the nine countries with the lowest life expectancy (12–20) have the lower average obesity rates. Western European countries, Japan, and Korea have lower obesity rates and higher life expectancy than the U.S., which also has the highest

Table 3. Life Expectancy, Obesity Prevalence, and Per Capita Health Expenditure for U.S. States in 2014

State	Life Expectancy in Years		Obesity Prevalence (%)		Expenditure/ Capita
	Women	Men	Women	Men	$
Hawaii	83.9	78.4	21.0	23.1	13,951
California	83.0	78.6	25.4	24.0	14,553
Minnesota	82.9	78.9	25.4	29.7	17,124
Connecticut	82.6	78.4	26.0	26.5	18,816
New York	82.5	78.1	26.2	27.8	18,466
Colorado	82.2	78.2	20.7	21.9	13,105
Florida	82.0	76.9	26.6	25.8	15,471
Washington	82.0	78.0	26.0	28.5	15,214
Idaho	81.4	77.6	29.2	28.7	13,363
Illinois	81.3	76.7	30.7	27.9	15,838
Virginia	81.2	77.1	29.3	27.7	14,518
Texas	80.8	76.2	30.7	33.2	13,522
Wyoming	80.7	76.7	29.2	29.7	16,298
Michigan	80.5	76.0	30.6	30.9	15,448
North Carolina	80.2	75.4	31.1	28.3	13,868
Georgia	79.7	75.0	32.4	28.6	12,607
Kentucky	78.8	73.7	29.9	33.3	15,413
Louisiana	78.6	73.1	35.7	34.0	15,234
Oklahoma	78.5	73.7	32.5	33.5	14,661
Mississippi	77.9	71.9	37.9	32.9	14,669

medical cost per capita. Developed countries, with a higher life expectancy (the first five countries) are mostly in the post-industrial stage, where the gap in obesity rate between males and females is small. In most of other countries (the bottom 15 countries), which have a relatively smaller service sector and larger agricultural and industrial sectors, women tend to have a much higher rate of obesity than men.

In Table 3, we see significant heterogeneity among states. Some of the coastal states tend to have a higher life expectancy and lower obesity rates than the Midwestern states and especially states in the South. The top states in terms of life expectancy have profiles that are close to Western Europe: 20–25% obesity rates and life expectancy above 80 for women and close to 80 for men. States with the lowest life expectancy, mostly southern states, have obesity rates well above 30% and male life expectancies closer to 70 than 80. The states with the lowest life expectancy spend less per capita on healthcare than the states with higher life expectancy.

Conclusions

This paper illustrates the value of examining issues from both a micro perspective, using individual-level data, and a macro perspective, using aggregated data. Micro-level results suggest that life expectancy and health are improved when BMI is in the range designated normal, and that individuals should modify their behavior to reach this range. Aggregate data, however, suggest that differences between communities exist, and policies like sugar or fat taxes, which may be appropriate in certain areas, may not be appropriate in developing countries where underweight is a major problem. Thus, nutrition policies need to be tailored to local circumstances and likely should change over time.

There are still regions that suffer from chronic undernutrition. Medical expenditure can compensate for nutritional deficiencies, but it may be preferable to modify nutritional choices to improve health and reduce medical expenses. The paper suggests that, overall, there is still insufficient consumption of calories in many regions, and reduction of caloric intake is not appropriate everywhere. In many developing countries, there is a need to enhance caloric consumption and diversify the diet.

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For additional information, the authors recommend:

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