Do People Associate Obesity with Poor Health?

Changes in the Socioeconomic Gradient in Obesity-related Health Knowledge

Jennifer Van Hook, Claire Altman, and Marianne Hillemeier

Abstract

Obesity is strongly linked to many negative health and mortality outcomes, yet it is unclear whether people associate obesity with poor health. Building from Link and Phelan's fundamental cause theory of health, we expect that those with higher levels of education will be more likely to recognize the health risks of obesity than those with lower levels of education. Additionally, we expect to see this pattern only in recent decades after the health risks of obesity have become more widely known. Because of data limitations, we cannot assess these ideas directly. Our approach is to use NHANES data collected across four decades to examine the relationship between body weight and self-rated health while controlling for as many other health conditions and behaviors as possible. If people believe that being overweight or obese worsens health, then this should be reflected in a lower SRH rating. Our preliminary findings confirm our expectations. The association between BMI and SRH is stronger at higher levels of education, but this pattern did not emerge until the early 1990s.

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Introduction

Socioeconomic status is strongly and consistently related to health. One particularly influential explanation of the SES-health gradient is the "fundamental cause" theory proposed by Link and Phelan (1995). They argue that the SES-health gradient persists across time and place because people with higher status are able to use their resources and knowledge to protect themselves from known health risks. Of key importance is the notion that *knowledge* about health risks and treatments protects higher-status individuals from risks in their environments. This idea is supported by studies showing that the SES gradient is steeper for causes of death that are treatable or preventable (Phelan, Link, Diez-Roux, Kawachi, and Levin 2004).

Here, we apply these ideas to a new and growing health risk: obesity. Obesity is strongly linked to many negative health and mortality outcomes, yet it is unclear whether people associate obesity with poor health. As we will discuss in our full paper, health is a multi-dimensional construct that taps into any of a number of factors, such as health behaviors, health conditions or problems, and functional limitations, that may or may not include obesity. Moreover, groups differ in the types of factors they emphasize when assessing health. Building from Link and Phelan's idea, we expect that those with higher levels of education will be more likely to recognize the health risks of obesity than those with lower levels of education.

A related idea we explore is Link and Phelan's notion that the SES-health gradient *for particular health risks* is likely to shift over historical time. They argue that there is unlikely to be a strong SES-health gradient for new or unknown health risks (such as in the case of HIV/AIDS in the early stages of the epidemic). However, a strong SES-health gradient is likely to emerge as higher status people adapt as health risks become known and preventive strategies are identified. For example, Link (2008) shows that knowledge about the linkage between smoking and lung cancer was initially unrelated to educational attainment. However, the education gradient increased as knowledge about the effects of smoking on cancer became more widely known. Significantly, the most highly educated were the first to adopt this knowledge, shortly after the Surgeon General's report on smoking.

We expect to see a similar pattern in the case of obesity. In particular, we expect education will be associated with knowledge about the health risks of obesity, but only in recent decades after the health risks of obesity have become more widely known. The strong linkage between obesity and negative health and mortality outcomes had not been studied by the medical and public health research community nor widely publicized until the late 1980s and early 1990s. Before this time, obesity may have been thought about in negative terms because of its implications for social status, attractiveness, and quality of life. But the belief that obesity itself should be treated as an indicator of poor health may not have been as widely held. For this reason, we expect that the association between education and the belief that obesity worsens health to be much weaker in the 1970s prior to the start of the obesity epidemic.

Overall, we are interested in differences and trends in people's perceptions of how their body weight relates to their health. Our key challenge is that no ideal data exist to directly address our research questions. There exist direct questions that ask people about reasons for losing weight (e.g., for health reasons?) in national surveys such as the NHANES, but these questions are only asked in recent years. We want to see how things have changed over several decades as the health risks of obesity have become more widely known.

Our approach is to examine the relationship between body weight and self-rated health while controlling for as many other health conditions and behaviors as possible. If people believe that being overweight or obese worsens health, then this should be reflected in a lower SRH rating. This is our key innovation. It permits us to assess educational differences in obesity-related health beliefs over several decades. The key measures necessary for the analysis—self-rated health, height and weight, and health conditions—have been measured in a consistent manner in the NHANES surveys since the early 1970s.

Background

In this section, we plan to review trends in the prevalence and SES gradient in adult obesity. Trends in the prevalence of obesity have been objectively monitored through health examination surveys beginning with the NHES I in 1960-62. Among adults the prevalence of obesity (BMI ≥ 30) increased only modestly from 1960-62 to the 1976-80 NHANES II (12.8% to 14.5%), but rose sharply in subsequent NHANES data to

22.5% by 1988-94 and 33.4% by 1999-00 (Flegal, Carroll, Kuczmarski, and Johnson 1998; Flegal, Carroll, Ogden, and Curtin 2010). The estimated obesity prevalence of 33.8% in 2007-08 indicates that rates remain high but have stabilized in recent years (Flegal, Carroll, Ogden, and Curtin 2010). Lower SES is associated with higher obesity prevalence although there is substantial variation in consistency and change in disparity among education and income subgroups over time (Chang and Lauderdale 2005; Zhang and Wang 2004).

This section will also review trends in public awareness about the health risks of obesity. We have learned, for example, that very little is known about the public's awareness of obesity as a pressing health issue. More is known about awareness of childhood obesity, however (Evans, Finkelstein, Kamerow, and Renaud 2005). We will next discuss the multi-dimensionality of self-rated health. Different groups tend to think about different things when rating their own health. For example, older people are more likely to think about health problems and functional limitations, while younger adults are more likely to emphasize health behaviors and obesity (Krause and Jay 1994). Despite these differences, however, self-rated health does tap into something very real (e.g., mortality, health conditions, etc.) (Franks, Gold, and Fiscella 2005; McGee, Liao, Cao, and Cooper 1998), and is related to obesity net of other kinds of health conditions or behaviors. Several studies have found that adults who are obese tend to rate themselves as having poorer health than non-obese individuals (Ferraro and Yu 1995; Manderbacka, Lundberg, and Martikainen 1999; Okosun, Choi, Matamoros, and Dever 2001). However, no studies have examined how the relationship between obesity and

self-rated health varies by socioeconomic status or across historical time. Our major contribution is to make these comparisons.

Methodology

Data and Sample. We pool several years of the National Health and Examination Survey (NHANES): NHANES I (1970-1974), NHANES II (1975-1980), NHANES III (1990-1994), and the continuous NHANES (1999, 2001, 2003, 2005, and 2007). The NHANES is a nationally representative study of the health and nutrition of children and adults aged 1 to 74 years old in the United States. The study has been conducted by the National Center for Health Statistics (NCHS) as a part of the Centers for Disease Control and Prevention since the early 1970s. Previous National Health Examination Surveys were conducted in the 1960s, but do not contain information on self-rated health or were conducted exclusively on samples of children and adolescents. The NHANES has a complex, multistage probability sample design. The NHANES collects demographic, socioeconomic, health and anthropometric data though interviews and examinations. While the target population is the civilian, noninstitutionalized U.S. population, oversampling procedures are used for particular sub-populations (i.e. Hispanics, Blacks, low income persons, etc.).

We restrict the sample to non-pregnant adults ages 20 and older. We exclude underweight individuals (with a BMI < 18.5) since weight gain for them may improve health. We exclude foreign-born persons since their ideas about health and obesity may differ systematically from natives. Finally, we excluded individuals with missing values

on any of the independent or dependent variables. The final sample size is 37,259 (NHANES I: 3,386; NHANES II: 10,274; NHANES III: 11,912; continuous NHANES: 11,687).

Measures. The dependent variable is self-rated health (1=Excellent, 2=Very Good, 3=Good, 4=Fair, and 5=Poor). The key independent variable is body mass index (weight in kg/(height in meters)^2). During the NHANES exam, technicians measured each respondent's height and weight. We used these measures to calculate each respondent's Body Mass Index (BMI). Another important independent variable was educational attainment, which we categorized into the following groupings: less than high school (reference category), high school graduate, attended some college, and college graduate.

We controlled for a number of socio-demographic characteristics, including race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, and non-Hispanic other), gender (male), age and age-squared. We also controlled for the number of chronic health conditions reported by the respondent among the following: asthma anemia, congestive heart failure, heart attack, stroke, bronchitis, emphysema, cancer hypertension, and diabetes. Finally, we controlled for smoking behavior: smoked at least 100 cigarettes in lifetime and currently smoke ("current smoker"), smoked at least 100 cigarettes but no longer smoke ("former smoker"), and never smoked 100 cigarettes ("non-smoker").

Models. We estimate ordered logit models predicting self-rated health. These models estimate the log odds of reporting worse health by one category (i.e., the logged odds of moving up one category in poor health) (DeMaris 1992).

To assess the relationship between body mass index and self-rated health, we estimate two models. Model 1 in Table 1 includes body mass index, educational attainment, and all the socio-demographic controls. Model 2 adds health conditions and smoking behavior. If body weight impacts individuals' assessments of their own health, the coefficient for BMI should be positive and significant (i.e., indicating an association with worse self-rated health), even after controlling for health conditions and behaviors in Model 2.

To assess whether those with higher levels of education are more likely to base their health rating on body weight, Model 3 in Table 1 tests interaction terms between educational attainment and BMI. We use post-estimation tests (available in Stata) to assess whether the two-way interaction effects are significant. If those with more education are more likely to view obesity as a health problem, their interaction terms should be both positive and significant. In other words, the association between BMI and poor health should be stronger as education increases.

Finally, to assess whether educational differences in the association of BMI with self-rated health change over time, we test three-way interactions among BMI, educational attainment, and time period of the data collection (NHANES I-early 1970s, NHANES II-late 1970s, NHANES III-early 1990s, and continuous NHANES-1999-2007), while including all underlying two-way interaction terms in the model. The three-way interaction terms were significant as a group. Because three-way interaction effects are difficult to interpret, we then estimated separate models for each of the four time periods. The results are displayed in Table 2. These models include the two-way

interaction between educational attainment and BMI, and the socio-demographic and health controls. We use post-estimation tests to assess whether the two-way and three-way interaction effects are significant. Finally, to more easily interpret the interaction effects, we use the linear combination commands in Stata to estimate the slopes for BMI by educational attainment and time period (results shown in Table 3).

Preliminary Results

Net of educational attainment and the socio-demographic characteristics, body mass index is significantly and positively associated with poorer self-assessments of health (Table 1, Model 1). A one-point increase in BMI is associated with a 5.5 percentage increase in the odds of reporting the next worse health category (because exp(.054) = 1.055). This relationship weakens somewhat but remains significant when health conditions and smoking behavior are controlled (Table 1, Model 2). A one-point increase in BMI is associated with a 4.5 percentage increase in the odds of reporting the next worse health category (because exp(.044) = 1.045). These results are consistent with prior research showing that obesity or body weight is significantly associated with poorer self-rated health.

[Table 1 about here]

Consistent with our expectations, the association between BMI and self-rated health varies significantly by educational attainment (Table 1, Model 3). The two-way interaction effects between BMI and educational attainment were highly significant ($p<.001$). The interaction effects indicate that the BMI-SRH relationship is significantly stronger at higher levels of education. For those with less than a high school degree,

the slope is .031. But the slope increases as education increases. The estimated slope is .041 (.031+.010), .049 (.031+.018), and .060 (.031+.029) for high school graduates, those with attended some college, and college graduates, respectively.

However, this educational pattern is relatively recent. The three-way interaction effects among BMI, educational attainment, and time period was statistically significant, indicating that the educational differences in the effects of BMI change over time. To reduce the number and complexity of interaction terms, we estimated separate models by time period (Table 2). The Education-BMI interaction was not significant in the early 1970s (based on the NHANES I sample) nor in the late 1970s (based on the NHANES II sample). However, the interaction effects were significant in the early 1990s (based on the NHANES III sample) and the 2000s (based on the continuous NHANES sample).

[Table 2 here]

To help interpret the interaction effects, we present the estimated BMI-SRH slope by educational attainment and time period in Table 3[1]. Generally, the BMI-SRH relationship was weak and insignificant for most educational groups during the early 1970s. By the late 1970s, the relationship was significant for all educational levels, but the slopes did not vary significantly across educational groups. In the early 1990s, however, an SES gradient emerged. The relationship was nearly three times (2.7) as strong for college graduates as those without a high school diploma. Finally, during the 2000s, the education gradient was slightly weaker but remained significant. The BMI-

[1] These estimates are based on the models shown in Table 2. For example, the slope for those with less than a high school degree (the reference category) in the NHANES I is equal to .011 (BMI). For high school graduates, it is .034 = .011 + .023 (BMI + BMI*HS).

SRH relationship was nearly twice (1.8) times as strong for college graduates as those without a high school degree.

[Table 3 here]

Discussion and Future Directions

In this study, we examine educational differences and trends in obesity-related health knowledge through the lens of fundamental cause theory. Because of data limitations, we are unable to examine trends in health knowledge directly. Rather, we gauge them indirectly with the association of body weight with self-rated health status. The results point to two important conclusions. First, they suggest that educational attainment appears to be associated with obesity-related health knowledge. The association of BMI with self-rated health is significantly stronger at higher levels of educational attainment. Second, the results suggest that this educational pattern is relatively new, emerging only in the past two decades. The health risks of obesity may not have been widely known before the early 1990s. As hypothesized by the fundamental cause theory, the education gradient on obesity-related health knowledge may not have emerged until after the health risks of obesity were understood, when those with more resources are the first to adopt and eventually respond to new information about health.

Of course, knowledge about the health risks of obesity may not lead to changes in behavior. Obesity is associated with lower levels of education (especially among

women), just like obesity-related health knowledge. However, the educational gradient in obesity itself appears to be much flatter today than in the past (especially for men), exactly the opposite pattern as we found for obesity-related health knowledge. This suggests a widening gap in which people have become increasingly aware of the risks of obesity at the same time that the prevalence of obesity has increased, particularly among those with higher levels of education. It would be interesting to explore whether awareness about the health risks of obesity is at all related to subsequent changes in diet and physical activity. If not, this would suggest that factors other than health knowledge underlie the obesity epidemic and disparities in the prevalence of obesity.

The results shown here are highly preliminary. We anticipate that revisions of the analysis will explore the following:

1) *Alternative models*. Here, we estimate ordered logit models. In subsequent analyses, we plan to also estimate logistic regression models that predict fair or poor health (or some other cut-off). We also plan to estimate the models while adjusting for the complex sample design of the NHANES.
2) *Alternative samples*. We plan to assess the sensitivity of the results to alternative sample definitions. For example, it may be problematic to include 20-24 year-olds in the analysis since they have not had the chance to complete their education yet. Ultimately, we will probably restrict the sample to ages 25+ rather than 20+. We also will explore whether the results differ by broad age grouping, gender, race/ethnicity, and immigration status, as sample sizes permit.

3) *Additional health controls*. We controlled for the number of health conditions and smoking behavior because these indicators were asked in all four NHANES surveys. However, we plan to conduct additional analyses in which we control for functional limitations. To do this, however, we will have to restrict the sample to the NHANES III and the continuous NHANES because no data on functional limitations were gathered in NHANES I or II. We also will explore the possibility of controlling for objective health based on measurements taken during the NHANES examination, such as blood pressure, diabetes, and anemia.

Table 1. Relationship of BMI and Educational Attainment with Poorer Self-rated Health (ordered logit models)

	Model 1		Model 2		Model 3		
Body Mass Index	0.054	***	0.044	***	0.031	***	
High School	-0.520	***	-0.441	***	-0.720	***	
Some College	-0.886	***	-0.791	***	-1.287	***	
College+	-1.382	***	-1.186	***	-1.988	***	
Body Mass Index x							
High School					0.010	+	a
Some College					0.018	**	
College+					0.029	***	
NH-White	-0.369	***	-0.465	***	-0.468	***	
NH-Black	0.006		-0.090		-0.091		
NH-Other	0.203	+	-0.003		0.003		
Male	-0.075	**	-0.036		-0.041		
Age (years)	0.023	***	0.029	***	0.029	***	
Age-squared	0.000		0.000	***	0.000	***	
NHANES II	-0.357	***	-0.483	***	-0.490	***	
NHANES III	-0.039		-0.037		-0.030		
Continuous NHANES	0.102	+	0.037		0.040		
Health Conditions			0.581	***	0.581	***	
Current Smoker			0.480	***	0.473	***	
Former Smoker			0.049		0.050		
Intercepts							
cutpoint 1	-0.055		0.102		-0.275		
cutpoint 2	1.507		1.731		1.359		
cutpoint 3	3.206		3.559		3.185		
cutpoint 4	4.954		5.455		5.076		
N	37,259		37,259		37,259		
Pseudo R-square	0.0553		0.0892		0.0895		

Source: Pooled NHANES I, NHANES II, NHANES III, and continuous NHANES (1999-2007)
Sample: Adults ages 20+, excluding pregnant women, immigrants, and underweight people (BMI<18.5)
*** p<.001 ** p<.01 *p<.05 +p<.10

[a] interactions significant as a group (p<.001)

Table 2. Changes over Time in the Relationship of BMI and Educational Attainment with Poorer Self-rated Health (ordered logit models)

	NHANES I (early 1970s)	NHANES II (late 1970s)	NHANES III (early 1990s)	Continuous NHANES (1999-2007)
Body Mass Index	0.011	0.033 ***	0.026 **	0.034 ***
High School	-1.206 *	-1.104 *	-0.847 **	-0.572 *
Some College	-0.791	-1.150 ***	-1.286 ***	-1.200 ***
College+	-1.457	-1.402 **	-2.546 ***	-1.828 ***
Body Mass Index x				
High School	0.023 ns	0.022 ns	0.011 b	0.008 c
Some College	-0.009	0.015	0.017	0.017 *
College+	0.008	0.006	0.044 **	0.027 *
NH-White	-0.611	-0.925 ***	-0.431 ***	-0.411 ***
NH-Black	-0.013	-0.116	0.099	-0.146 +
NH-Other	1.294 +	-0.378	-0.128	0.024
Male	0.132	0.097 *	-0.083	-0.054
Age (years)	0.079 ***	0.044 ***	-0.012	0.015 +
Age-squared	-0.001 **	0.000	0.000 **	0.000
Health Conditions	0.730 ***	0.632 ***	0.639 ***	0.596 ***
Current Smoker	0.123	0.302 ***	0.528 ***	0.559 ***
Former Smoker	0.152	0.025	0.081	0.067
Intercepts				
cutpoint 1	0.515	0.926	-1.421	-0.594
cutpoint 2	1.840	2.375	0.338	1.100
cutpoint 3	3.783	4.085	2.294	2.933
cutpoint 4	5.705	5.746	4.350	4.857
N	3,386	10,274	11,912	11,687
Pseudo R-square	0.0855	0.1065	0.0975	0.0876

Source: NHANES I, NHANES II, NHANES III, and continuous NHANES (1999-2007)
Sample: Adults ages 20+, excluding pregnant women, immigrants, and underweight people (BMI<18.5)
*** p<.001 ** p<.01 *p<.05 +p<.10

[a] interactions significant as a group (p<.001)

Table 3. Relationship of BMI with Self-rated Health by Educational Attainment and Time Period

	NHANES I (early 1970s)	NHANES II (late 1970s)	NHANES III (early 1990s)	Continuous NHANES (1999-2007)
Association of BMI with SRH				
Less than HS	0.011	0.033 ***	0.026 **	0.034 ***
HS	0.034 *	0.055 **	0.037 ***	0.043 ***
Some College	0.001	0.048 ***	0.043 ***	0.051 ***
College+	0.019	0.040 *	0.070 ***	0.061 ***
Education Differences Significant?	NO	NO	YES (p=.013)	YES (p=.047)

Source: NHANES I, NHANES II, NHANES III, and continuous NHANES (1999-2007)
Sample: Adults ages 20+, excluding pregnant women, immigrants, and underweight people (BMI<18.5)
*** p<.001 ** p<.01 *p<.05 +p<.10

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