The effect of obesity on intergenerational income mobility

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Abstract: For this paper, we examine the effect of obesity on intergenerational mobility. Utilizing NLSY79 data, we compare the likelihood of upward mobility by obesity status (normal, overweight and obese) and gender. Using temporal ordering to establish a direction of causality, we examine parental income when the child was living at home, body mass index in early adulthood, and adult family income at age 38-43. We find that obesity dampens upward mobility and increases downward mobility for overweight and obese women, but do not find the same trends for overweight and obese men.

Introduction

Obesity has increasingly become a national health concern of epidemic proportions. The most recent Centers for Disease Control (CDC) data indicate that the national obesity prevalence reached an all-time high of 33% in 2006, with more than 16% of children and adolescents obese (Ogden et al, 2007). Overweight and obese individuals are at increased risk of a range of medical conditions, including coronary heart disease, type-2 diabetes, cancer, sleep apnea, and reproductive dysfunction. Medical costs associated with overweight and obesity were $92.6 billion (2002 $) in 1998 and accounted for at least 9% of all national health care spending (Finkelstein, Fiebelkorn, & Wang 2003). More than ten years later, the costs have surely increased with obesity's increased prevalence. In addition to health care spending, obesity has many socioeconomic costs, with vast research detailing correlates between socioeconomic status (SES) and weight.

Overweight and obesity are expensive, both nationally and personally. It is estimated that overweight and obesity are responsible for 5-7% of all annual medical costs (Wolf & Colditz, 1994; Finkelstein, Fiebelkorn, & Wang 2003), driven in part by the fact that obese individuals spend $10,000 more in lifetime medical expenses due to related medical conditions (Bhattacharya & Sood, 2004). The overweight and obese also experience declines in wages and lifetime earnings compared to those of normal weight (Wada and Tekin, 2007). Aside from increased medical costs, a number of mechanisms have been hypothesized to mediate this relationship, including decreased probabilities of marriage (Mukhopadhyay, 2008), lower spousal earnings (Averett & Korenman, 1996), and labor market discrimination (Baum & Ford, 2004).

While much has been written on SES's ability to predict obesity, there have been no

studies examining obesity's effect on intergenerational mobility. This paper should begin fill this gap. We hypothesize that obesity will have a dampening effect on upward mobility, preventing obese individuals from realizing equal economic opportunity in comparison with their normal weight counterparts, and that this effect will disproportionately impact women. To examine the impact of overweight and obesity on intergenerational mobility, we use data from the National Longitudinal Survey of Youth 1979 (NLSY79), a nationally representative sample.

Literature Review

While there have been no prior studies examining obesity's direct effect on mobility, there is a substantial body of research on the many ways in which obesity could influence mobility. Although causal direction is often difficult to establish in obesity studies, obesity is correlated with a number of relevant socioeconomic indicators, such as educational attainment and income (Wang & Beydoun, 2007). However, the strength of these relationships is reduced after accounting for race and ethnicity, both of which are consistently strong predictors of obesity (Zhang & Wang, 2004).

Obesity and its economic outcomes are also differentiated by gender. While only 52% of women are overweight or obese, compared to 69% of men, a number of studies have demonstrated that obesity tends to affect women to a greater degree. Overweight and obese individuals have been shown to have lower wages than peers of normal weight, with much of the wage penalty falling on obese women (Baum & Ford, 2004; Han, Norton, & Stearns 2008; DeBeaumont, 2009). This tendency for lower wages has been attributed to labor market discrimination against obese women.

Obesity also interacts with marriage and mating. Assortative mating – the tendency for a

species to choose a mate with similar phenotypic or cultural characteristics – may contribute to two obese or relatively disadvantaged individuals marrying each other (Hebebrand et al, 2000; Speakman et al, 2007). In their study of obesity and marriage rates, Fu and Goldman (1996) employed Becker's theory on the stylized formulation of assortative mating, which implies that men are more likely to be concerned with their spouse's social and physical characteristics, while females value their future partner's socio-economic characteristics. Their model identified significantly lower marriage probabilities for obese women compared to obese men. In a study of obesity's effect on cohabitation and marriage, Mukhopadhyay (2008) found that after controlling for variables that affect marriage probabilities, obese women were significantly less likely to cohabitate or marry than other women and men of all weight groups.

This paper will examine how overweight and obesity affect intergenerational economic mobility, a relationship that has gone unexplored. The level of upward intergenerational mobility – that is, moving up in the income distribution, relative to parental position – is considered a key indicator of equality of opportunity among a population (Van de Gaer, Martinez, & Schokkaert, 1999). The presence of opportunity should theoretically erase much of an individual's birth circumstances. Mobility is usually measured in one of two ways: through occupation and income. Both measures have a number of methodological limitations - occupations are difficult to rank and income reports are subject to recall bias - but are used to answer a variety of research questions. This study will employ family income mobility.

Data

Our research is based on an analysis of the National Longitudinal Survey of Youth 1979 (NLSY79), a nationally representative longitudinal survey of individuals who were 14-22 years

old in 1979. Individuals in this survey were interviewed annually from 1979-1994 and biannually from 1994-2006. The NLSY79 covers a wide range of health and economic questions asked repeatedly throughout the respondent's life. The original sample size was 12,686 individuals. Retention rates for this survey have been approximately 70% over the survey's 27-year duration.

The method of data collection has varied over the years. In-person interviews were conducted from 1979-1986 and 1988-2000, while telephone interviews were conducted in 1987 and 2002-2006. Computer-assisted interviewing replaced paper-and-pencil interviewing in 1993.

To identify intergenerational mobility, we restrict our survey to individuals who were 14-22 years old and living at home in the years that parental income was collected. We allow average log parental income to be collected between 1979-1982 to increase the sample size, as item non-response for income was fairly high in any given year (40-60%). The sample is restricted to children with parents aged 16-40 years old at child's birth and, therefore between age 31-61 at measurement of parents' income. We measure child income as a respondent's average log family income between age 38 and 43. BMI is measured between age 20-24 and women who were pregnant at the time of BMI measurement are excluded from the sample. We further restrict our survey to individuals who reported valid parent family income, BMI, and income at age 38-43. After all of these restrictions, the sample size is 4,970 individuals.

Family income includes all sources of income from individuals in the household older than 14 years old, before taxes or other deductions. All dollar values are converted to 2005 dollars using the Consumer Price Index for Urban Consumers, Research Series (CPI-U-RS).We measure obesity using the imperial body mass index (BMI) formula (weight in pounds*703 divided by height in inches squared) for individuals from ages 20-24. Height and weight questions were asked in 1981, 1982, and 1985. We use linear interpolation to impute the height

and weight for1983 and 1984. We divide race/ethnicity into four categories: non-Hispanic White, non-Hispanic Black, Hispanic, and other. We divide education into less than high school degree, high school diploma, some college and four-year college degree and more.

Methodology

We follow the methodology used by Hertz (2004) and Bratberg, Nilsen & Vaage (2007) to measure mobility by comparing parent family income to child family income. Mobility is measured as income elasticity from one generation to the next. Average log family income from 1979-1982 is age-adjusted by regressing parents' income on average parent age and age-squared and using the residual from the regression (including the constant term) as the income measure (Bratberg et al, 2007).

Once we create age-adjusted log income measures, we create an OLS model regressing child family income on parent family income by obesity status (i.e., normal, overweight, or obese), producing an intergenerational mobility elasticity differentiated by obesity status. Based on analyses of the impact of obesity on wages (Register & Williams, 1982; Pagan & Davila, 1997), we predict that obesity's effect on mobility will be felt most strongly by women. As such, we also divide the regression models by gender.

Previous research has shown that mobility differs at different points in the outcome income distribution (Eide & Showalter, 1999; Grawe, 2004). Quantile regression by obesity status demonstrates the income elasticities at different points in the children's income distribution. This method will help us examine how much of a person's income can be attributed to their parents' income and how this relationship varies across the income distribution. We examine the income elasticities overall, by obesity status and by obesity status and gender at the

20^{th}, 40^{th}, 60^{th}, and 80^{th} income percentiles. We use bootstrapped standard errors to reduce the potential for bias due to heteroskedasticity (Rogers, 1992).

Following the methodology established by Hertz (2004), we augment the results from the regressions with transition matrices. While the regressions estimate the likelihood of movement from one generation to another, transition matrices provide additional information regarding the proportion of upward or downward mobility at a given income quintile.

Results

The sample summary statistics in Table 1 illustrate that while obese and overweight individuals begin childhood relatively equally distributed by income (with the exception of the top quintile), they are more likely to be in the lowest income quintiles and less likely to be in the highest income quintiles by adulthood. The distribution of BMI in the top quintile indicate that overweight and obese individuals are less likely than normal BMI individuals to come from relatively advantaged parents. Further, while the under-representation of overweight and obese individuals in the top quintile is steady across both generations, the gap between obese and normal weight individuals in the bottom quintile quadruples between childhood and adulthood.

Table 1a provides additional information about the distribution of parental income for obese individuals by gender. Given that we hypothesize that gender modifies the effect of obesity on mobility, this table shows that obese men and women start in very different places in the income distribution. Obese women are clustered around the lower income quintiles, while obese men are overrepresented in the middle and high-income brackets. This indicates that obese women are more disadvantaged from childhood, a fact that could restrict access to opportunity structures or otherwise make income mobility more difficult.

Table 1b illustrates the distribution of marriage by gender across BMI categories. We see

in this table that marriage rates for obese women are much lower than marriage rates for every other group. Given that marriage can be a pathway to greater family income, this too highlights a particular challenge obese women face.

Table 1. Sample summary statistics

		BMI Status				
	Overall	**Normal BMI**	**Overweight**	**Obese**	**Difference: overweight & normal**	**Difference: obese & normal**
	Mean / %	Mean / %	Mean / %	Mean / %		
Parent family income (2005$)						
Ln family income	10.64	10.65	10.61	10.51	-0.04	-0.15 **
Bottom quintile	20%	20%	21%	23%	1.5%	3.7%
Second quintile	20%	20%	20%	24%	0.1%	4.3%
Third quintile	20%	20%	20%	24%	0.4%	3.9%
Fourth quintile	20%	20%	21%	19%	0.8%	-0.8%
Top quintile	20%	21%	18%	10%	-2.9%	-11.1% ***
Child family income (2005$)						
Ln family income	10.76	10.79	10.69	10.46	-0.10 **	-0.33 ***
Bottom quintile	20%	19%	21%	31%	1.5%	12.0% ***
Second quintile	20%	20%	22%	20%	2.1%	0.8%
Third quintile	20%	19%	22%	22%	2.1%	2.9%
Fourth quintile	20%	20%	20%	14%	0.0%	-6.6% **
Top quintile	20%	21%	16%	12%	-5.7% ***	-9.0% ***
BMI						
BMI (age 20-24)	23.26	21.76	26.81	33.51	5.05 ***	11.75 ***
Race						
Non-Hispanic White	53%	54%	52%	47%	-2.1%	-6.4% *
Non-Hispanic Black	29%	29%	28%	34%	-1.6%	4.3%
Hispanic	16%	15%	19%	17%	3.8% **	2.0%
Education						
> HS	8%	7%	9%	9%	2.0% *	1.4%
HS	39%	37%	43%	49%	5.5% **	11.1% ***
Some College	22%	23%	21%	22%	-2.0%	-1.1%
BA+	22%	24%	18%	12%	-5.5% ***	-12.1% ***
Family Status						
Married	57%	58%	55%	46%	-3.6%	-12.6% ***
With children	80%	81%	78%	72%	-3.3% *	-8.8% ***
Number of children	2.37	2.36	2.43	2.40	0.07	0.04
Basic Demographics						
Female	47%	49%	33%	56%	-16.5% ***	7.1% ***
Age	44.29	44.21	44.53	44.76	0.32 ***	0.55 ***
U.S. Born	94%	94%	93%	96%	-0.8%	2.7% *

*** p<0.01, ** p<0.05, * p<0.1

Educational differences by BMI status in Table 1 are quite substantial. Overweight and

obese individuals are less likely to receive a college degree than are normal weight individuals, with most of the obese and overweight earning high school diplomas. Additionally, obese and overweight individuals are less likely to be married or have children. Hispanics are disproportionately overweight and Non-Hispanic Blacks are disproportionately obese. Females are also disproportionately obese. These differences in education, marital status, gender, and race will likely account for some of the income differences we see by BMI status.

Table 1a. Parental income distribution of obese individuals by gender

	Obese overall	Obese men	Obese women
Income quintiles			
Bottom quintile	23%	12%	32%
Second quintile	24%	19%	28%
Third quintile	24%	27%	21%
Fourth quintile	19%	30%	11%
Top quintile	10%	12%	8%

Table 1b. Percent married by BMI status & gender

	Men	Women
BMI status		
Overall	55%	51%
Normal	54%	55%
Overweight	56%	40%
Obese	50%	32%

Table 2 contains age-adjusted bivariate intergenerational income elasticities. These elasticities can be interpreted as intergenerational log income correlations in which an elasticity of 0.44 (as in the full sample) indicates that a 10% difference in parental income would lead to a 4.4% difference in child income. Lower elasticities indicate higher intergenerational mobility, but do not indicate the direction of that mobility. The results for the full sample are consistent with

other research that finds intergenerational elasticities ranging between 0.3-0.5 (Solon, 1999). The overall elasticities in each BMI category do not deviate much from the full sample elasticity. The exception to this trend is that obese individuals have an overall elasticity eight points lower than

Table 2: Bivariate intergenerational income mobility estimates

Elasticities	**Overall**	**Male**	**Female**
Overall	0.4406***	0.4173***	0.4624***
	(0.02)	(0.02)	(0.02)
Normal	0.4429***	0.4313***	0.4548***
	(0.02)	(0.03)	(0.03)
Overweight	0.4264***	0.3987***	0.4092***
	(0.04)	(0.05)	(0.06)
Obese	0.3604***	0.1153	0.3111***
	-0.1	(0.19)	(0.12)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

the full sample, indicating higher overall mobility. In the full sample and in every BMI category, females have higher elasticities and therefore lower mobility. This is especially true for obese women, who experience three times less mobility than obese do men. Because of small sample sizes, caution should be used in interpreting elasticities for obese individuals.

Table 3 presents estimates of intergenerational income elasticities controlling for marital status. We control for marital status to better understand the role it plays in modifying the effect

Table 3: Multivariate intergenerational income mobility estimates

Age-Adjusted

	Overall					
	Overall	*Male*	*Female*	**Normal**	**Overweight**	**Obese**
Parent Income	0.3424***	0.3269***	0.3556***	0.3420***	0.3440***	0.2754***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.09)
Married	0.7988***	0.7599***	0.8421***	0.8139***	0.7503***	0.6600***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)	(0.13)
Constant	10.2989***	10.3453***	10.2483***	10.3097***	10.2864***	10.1919***
	(0.02)	(0.02)	(0.03)	(0.02)	(0.04)	(0.09)
Observations	4970	2653	2317	3817	912	241
R-squared	0.29	0.27	0.32	0.30	0.28	0.15

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

of obesity on mobility. The mobility patterns for the overall sample are similar to those found in Table 2, but we can also see that marriage has a stronger effect on female mobility than for males. Similarly, mobility patterns across BMI groups are similar with those found in Table 2, but the effect of marriage across groups is quite different. Although marriage is significantly and positively correlated with adult income, the effect decreases for overweight and obese individuals.

From Table 4, we can see that while obesity does not dampen upward mobility, it increases the likelihood of downward mobility (See Appendix A for full matrices). Interestingly, overweight individuals have slightly reduced upward mobility compared to normal weight individuals, but they are not more likely to have downward mobility.

Table 4: Mobility direction

		BMI Status		
	Overall	*Normal*	*Overweight*	*Obese*
Full sample				
Upward	35%	35%	34%	35%
Downward	35%	34%	35%	39%*

None	30%	30%	31%	26%*
Men				
Upward	35%	34%	35%	41%*
Downward	35%	35%	34%	38%
None	30%	31%	31%	21%**
Women				
Upward	35%	36%	31%**	31%*
Downward	34%	33%	37%	40%*
None	30%	30%	32%	29%

However, when these results are broken down by gender, a very different picture emerges. Cell sizes become smaller, so caution should be used in generalizing these results. Both overweight and obese women have considerably lower upward mobility and higher downward mobility than do normal weight women and all categories of men. Surprisingly, obese men have much higher upward mobility than normal weight men (41% likelihood of upward vs. 34%). These results highlight the important relationship between gender and obesity.

Discussion

These results present a complicated picture of overweight and obesity's effect on income mobility. As supported in the literature, obese individuals are more likely than normal weight individuals to come from disadvantaged childhoods and less likely to come from advantaged childhoods. These discrepancies in SES of origin may influence access to opportunity structures – such as education – that promote mobility. The various measures of elasticity and transition utilized in this paper help identify the mobility trends and magnitude of those trends for individuals across BMI groups. We find that obese individuals have much lower income elasticities than other groups and have greater downward mobility. Obese women experience more downward mobility than men, with the downward mobility gap between normal and obese women more than twice that for men. Overweight women also are more likely to experience

downward mobility than are their male counterparts.

The gender differences between men and women, especially obese men and women, are striking. Obesity appears to compound disadvantage in our sample, making upward mobility more difficult for those individuals beginning in the lowest income quintiles. Table 1a shows us that obese women – who have the highest probability of downward mobility – disproportionately begin in the lower income quintile, while obese men – who have the highest probability of upward mobility – begin in the higher income quintiles. Obese men are able to leverage this capital into upward mobility.

There are a number of possible factors that mediate obesity's affect on mobility. A pathway clearly supported by the literature is that overweight and obese women experience labor market discrimination that reduces their wages. Social norms regarding women's appearance exist to a degree not expected for men. Wages of overweight and obese women may suffer because of this through employer or customer bias; given that women are more likely to work in customer service-oriented industries, pressure for appearance conformity may be especially hard felt. Men do not tend to suffer the same penalties for appearance, perhaps because expectations for appearance are lower or because men tend to work in non-customer service oriented industries in which appearance matters less. However, because we do not have intergenerational wage data, this theory is not testable in this study.

Given that we are examining mobility in terms of family income, it is important to consider the role of marriage and spouse selection. Much like in the workplace, overweight and obese women pay a marriage penalty that men do not, likely because many of the same social norms that exist in the labor market also exist in the marriage market. This penalty may come in the form of simply being unmarried, or by marrying someone who has lower earning power.

Because of the same cultural norms that pathologize heaviness among women, heavier men may in fact be seen as prosperous by potential mates because their supposed success has allowed these men to consume more. In this study, overweight and obese women were disproportionately unmarried when compared to normal weight women and overweight and obese men.

This paper provides further evidence of overweight and obesity's deleterious effect on socioeconomic status by increasing downward intergenerational mobility, especially for women. Policy and programmatic interventions should especially target obese women, as this paper provides evidence of weight's powerful influence on access to opportunity structures and future income.

This study suffers from two primary limitations. First, after restricting the overall sample to respondents with valid BMI and income data, the sample is reduced by more than half, placing the study at risk for unobserved selection bias. Related to this, the sample sizes for obese respondents are quite small. Increasing the overall sample would improve this. The validity of this study could be improved through imputation techniques. Future studies would benefit from oversampling of overweight and obese individuals. Although outside the scope of this study, it remains unclear what factors mediate the relationship between obesity and income mobility and how these pathways interact with gender. Future research should attempt to identify the many mediators supported in previous research.

Appendix A: Transition matrices by BMI status

Key:

Upward Mobility
No Change
Downward Mobility

Overall Transition Matrix

	Child quintile					
Parent quintile	1	2	3	4	5	**Total**
1	**391**	260	175	95	73	994
2	255	**255**	209	163	112	994
3	175	198	**213**	226	182	994
4	105	176	215	**258**	240	994
5	68	105	182	252	**387**	994
Total	994	994	994	994	994	4970

Overall Transition Matrix if BMI=Normal

	Child quintile					
Parent quintile	1	2	3	4	5	**Total**
1	**288**	191	122	82	63	746
2	188	**195**	153	128	91	755
3	124	145	**165**	174	145	753
4	82	133	169	**183**	192	759
5	49	83	134	209	**329**	804
Total	731	747	743	776	820	3817

Overall Transition Matrix if BMI=Overweight

	Child quintile					
Parent' quintile	1	2	3	4	5	**Total**
1	**75**	56	43	10	8	192
2	48	**50**	40	29	14	181
3	36	38	**39**	42	29	184
4	17	33	38	**63**	38	189
5	12	21	37	41	**55**	166
Total	188	198	197	185	144	912

Overall Transition Matrix if BMI=Obese

	Child quintile					
Parent quintile	1	2	3	4	5	**Total**
1	**28**	13	10	3	2	56
2	19	**10**	16	6	7	58
3	15	15	**9**	10	8	57
4	6	10	8	**12**	10	46
5	7	1	11	2	**3**	24
Total	75	49	54	33	30	241

Appendix B: Intergenerational income mobility estimates, quantile regressions

Bivariate Analysis, Age-Adjusted

	20th	40th	50th	60th	80th	No. of obs
Overall	0.5766***	0.4822***	0.4287***	0.3931***	0.3431***	4970
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	
Normal	0.5835***	0.4799***	0.4232***	0.3983***	0.3329***	3817
	(0.04)	(0.03)	(0.02)	(0.02)	(0.02)	
Overweight	0.5471***	0.4735***	0.4290***	0.3784***	0.3327***	912
	(0.07)	(0.04)	(0.05)	(0.04)	(0.04)	
Obese	0.5445***	0.4923***	0.4064***	0.2815**	0.4244***	241
	(0.14)	(0.13)	(0.11)	(0.11)	(0.07)	
Male						
Overall	0.5485***	0.4486***	0.3989***	0.3739***	0.3429***	2653
	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)	
Normal	0.5552***	0.4627***	0.4100***	0.3895***	0.3626***	1935
	(0.05)	(0.04)	(0.03)	(0.02)	(0.03)	
Overweight	0.5340***	0.4261***	0.3571***	0.3416***	0.3071***	613
	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	
Obese	-0.0424	0.1123	0.1972*	0.3183**	0.3829***	105
	(0.34)	(0.11)	(0.12)	(0.14)	(0.11)	
Female						
Overall	0.6144***	0.5150***	0.4639***	0.4240***	0.3429***	2317
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
Normal	0.6181***	0.4960***	0.4393***	0.3943***	0.3194***	1882
	(0.05)	(0.05)	(0.03)	(0.04)	(0.03)	
Overweight	0.4279***	0.4808***	0.4599***	0.4274***	0.3717***	299
	(0.11)	(0.10)	(0.07)	(0.06)	(0.06)	
Obese	0.2012	0.4076***	0.4932***	0.4064***	0.2866***	136
	(0.21)	(0.15)	(0.17)	(0.15)	(0.09)	

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Note: Income elasticities are relatively stable for the full sample across all quantiles of child family income by BMI status. Additionally, most groups in the table show a decline in elasticity as they move up the income scale as adults. This indicates that, as expected, that as children earn higher incomes they will likely deviate further from their parents' incomes. The data on obese males and overweight and obese females are exceptions to this trend. With the exception of one quantile, obese men have lower elasticities across quantiles compared to the full male sample, consistent with the overall OLS finding. Overweight women tend to have higher elasticities than

the full female sample and these elasticities begin to trend upward across quantiles, indicating less mobility at the higher end of the income spectrum. Although obese women trend downward across the income distribution, they begin to do so later than other groups and the drop in elasticity is much more precipitous (from 0.32 at the 40^{th} quantile to 0.14 at the 80^{th} quantile). As obese women move further up the income scale as adults, they deviate much more from parental income than other groups.

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