Race, obesity, and the puzzle of gender specificity†

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Abstract

Obesity rates, average weights, and median weights all differ significantly between African-American (non-Hispanic) and white (non-Hispanic) women in the United States, even after controlling for differences in income, education, age, geographic location, and several other factors (Chou et al. 2004, Cutler et al. 2003). Not surprisingly, African-American women experience considerably higher rates of obesity-related diseases than white women, a fact that can explain a significant portion of the difference in life expectancy between these two groups. These differences have persisted without much alteration since the early 1970s, despite substantial increases in obesity rates among both groups. This paper considers a number of explanations for these disparities focusing, variously, on economic factors, physiological factors, and sociocultural factors. Drawing on numerous data sources pertaining to adult American women and men spanning three decades, we argue that explanations based on either economic or physiological factors are inadequate. We present evidence that differences in physical ideals between whites and African-Americans, together with lower stigmatization of overweight among black women, contribute to the differences between white and black women. To conclude, we describe the rudiments of a model in which race- and gender-specific physical ideals emerge endogenously in relation to the current and past wealth and BMI distributions in the same-race population.

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1 Introduction

The dramatic increase in obesity prevalence in the United States over the past three decades has been well-documented, both in the popular media and in diverse academic outlets. Although these increases have occurred among both men and women, across all racial and ethnic groups, and across all socioeconomic strata, large differences in obesity prevalence between African-American (non-Hispanic) women and white (non-Hispanic) women have persisted throughout this period. Table 1 gives age-adjusted obesity rates[1] for white women and African-American women ages 20 and higher, as measured via direct examination in the National Health and Nutrition Examination Surveys (NHANES) II (1976-1980), III (1988-1994), and NHANES 1999-2004.[2] The obesity rate for African-American women exceeded that of white women by 15.6 percentage points (on average) during the period covered by NHANES II, by 15.8 percentage points during the period of NHANES III, and by 20 percentage points on average between 1999 and 2004. The differences in (survey-weighted) mean BMI among the 20+ age group for each of the NHANES II, III, and ’99-’04 surveys were 2.5, 2.95, and 3.6 units, respectively. The BMI differences get progressively larger at higher percentiles of the distribution: for example, in NHANES III we observe a gap of 4.2 units between the 95th percentile BMI values for black women and white women ages 20 years and up.

Not surprising in light of the disparities in obesity rates, we observe significant disparities in health outcomes related to excess body weight between these two groups: the remaining lifetime risk at age 18 of developing diabetes, for women with BMI between 25 and 30, was estimated at 39.3% for African-American women and 30.7% for white women. The difference in risks from age 18 increased when comparing women with BMI above 30; the pattern of race differences was about the same for remaining lifetime risk as of age 45 (Narayan et al. 2007). Risks of heart disease and hypertension are also

[1] BMI is the ratio of weight, measured in kilograms, to squared height, measured in meters. The definition of obesity employed by the Centers for Disease Control (CDC) is a BMI value of 30 or greater. A woman 5’4” tall and weighing 175 pounds or greater classifies as obese; a 5’9” male weighing 203 pounds or greater is obese.

[2] Age-adjusted data by race and sex are not available for surveys prior to NHANES II; non-age-adjusted figures by race and sex are available for the National Health Examination Survey (NHES) I, covering 1960-62, and for NHANES I, covering 1971-74. (Health, United States, 2006, CDC.)

significantly greater among black women than white women (Must et al. 1999). These differences contribute to the lower life expectancy of black women relative to whites, by 4.7 years at birth and by 3 years at age 50 (Arias 2004).

Racial and ethnic differences in obesity rates have been studied primarily by researchers in the fields of public health, psychology, and sociology. The public health literature has documented these differences and proposed various explanations, including both socioeconomic and physiological factors.[3] The psychology and sociology research has found that black women hold a different (larger) body size ideal than do white women and have different perceptions of own size relative to public health standards.[4] Although this literature has suggested that such cultural differences contribute to differences in obesity rates, this hypothesis has not been tested rigorously. The economic literature on obesity, while not addressing race differences directly, offers a list of factors, such as income and prices, that might account for such differences.[5] The current inquiry examines these competing explanations, attempting to quantify the respective contributions of standard socioeconomic factors such as age, location, income, food prices, and educational attainment; behaviors such as smoking, physical activity, labor force participation, and child-bearing; physiological factors such as metabolism and body composition; and sociocultural influences such as notions of ideal weight, social stigmatization of overweight and obesity, and penalties for same in labor and marriage markets. We argue that economic and physiological factors (either alone or in combination) are insufficient and that ethnic differences in social norms pertaining to ideal female size contribute significantly to the different outcomes.

We evaluate the various explanations using multiple, complementary approaches. First, we conduct

[3]Purely descriptive papers include Ogden et al. 2006, Flegal et al. 1998, and Dawson 1988; articles examining cultural and socioeconomic factors include Stevens et al. 1994 and Kumanyika et al. 1993; those citing physiological differences include Martin et al. 2004, Sharp et al. 2002, Weyer et al. 1999, Carpenter et al. 1998, Foster et al. 1997, and Yanovski et al. 1997. Sobal 2001, and Kumanyika 1987, 1994, and 1999 consider multiple hypotheses.

[4]For a survey of this literature, see Flynn and Fitzgibbon 1998; more recent studies include Lovejoy 2001 and Fitzgibbon et al. 2000.

[5]Lakdawalla and Philipson 2002 and Philipson and Posner 1999 use declines in food prices and in the physical requirements of labor to explain long-term secular increases in obesity; Cutler et al. 2003 emphasize declines in the time cost of food preparation to explain the particularly sharp increase in obesity since the early 1980s. Chou et al. 2004 identify smoking and fast-food restaurant density as factors in obesity incidence. Burke and Heiland 2007 argue that social interactions on body weight magnified the effects of lower food prices on obesity.

multivariate analysis of NHANES and BRFSS data spanning more than three decades.[6] This analysis demonstrates the robustness of black-white female differences in mean BMI and obesity prevalence to factors unrelated to the purported race differences in social preferences over body weight, such as age, educational attainment, income and food prices. The residual race effect in these models represents an upper bound estimate of the contribution of sociocultural factors. Next, we evaluate explanations based on unobserved differences in incentives and constraints, such as race differences in the health costs of obesity or in resting metabolism. To this end, we exploit the fact that, with some exceptions, we observe little to no significant differences in mean BMI values or obesity rates between African-American and white men. We also consider differences in social influences and cultural values such as notions of ideal weight, social stigmatization of overweight, and penalties for overweight in labor and marriage markets.

We evaluate the various explanations by generating additional testable predictions consistent with each and examining, when available, additional evidence that bears on such predictions. In this regard we exploit the puzzling fact that, with some exceptions, we observe little to no significant differences in mean BMI values or obesity rates between African American and white men. We argue that explanations based solely on socioeconomic, demographic, and physiological factors (either alone or in combination) are insufficient and that racial differences in social norms pertaining to female size and shape contribute significantly to the different outcomes. Rather than invoking arbitrary norms, however, we cite evidence from sociology and other disciplines that documents differences in norms of body size (and body composition) by race and gender, differences that appear to be enforced both externally and internally. Finally, we sketch out a theoretical framework within which such norm differences could have emerged and persisted endogenously under the influence of historical conditions.

[6]The BRFSS is a separate CDC survey that measures weight and height, desired weight, numerous health-related behaviors and demographic information based on telephone interviews of very large random samples (repeated cross sections) of the non-pregnant resident population 18 years and older in participating states of the US.

2 Conceptual Background

2.1 Determinants of BMI

The “choice” of BMI represents a complex problem that is unlike the choice of standard consumption goods. (Because we are focusing on adults, we assume height is fixed so that only changes in weight can induce changes in BMI.) In a proximate, structural sense, weight can be viewed as a stock that evolves as a function of energy intake and energy expenditure. However, energy intake and expenditure are determined by a combination of human choices and involuntary biological processes. The biological factors are idiosyncratic, complex, and not readily observable to the individual. The human inputs depend on preferences over food and physical activity and on preferences over the weight outcome, preferences which may come into conflict with each other. The human choices also depend on constraints such as prices, income, technology and the natural and built environment. Preferences over weight (or BMI) itself are likely to be complex, as the outcome affects not only physical health in the present and the future, but also possibly mental health and economic and social opportunities. These latter consequences–for example, social stigmatization of obese individuals–may themselves be determined as a function of population outcomes (as we have argued in our previous works, Burke and Heiland 2006 and Burke and Heiland 2007). To add even greater complexity, the contributions of BMI to health, longevity, and social and economic well-being may vary across individuals and are not known with certainty to any given person.

In order to write down a workable model of the process of BMI determination that can be used as a guide for empirical work, we will have to abstract considerably from such complexity. First, we will assume that the choice problem results in a unique (non-path-dependent) optimal, “equilibrium” value of BMI (for the given preferences, endowments, and constraints) that is stable over time and that individuals are observed in equilibrium. We assume that for the given optimal BMI, there is a unique combination of choices of food intake and elective physical activity that maximize utility subject to achieving that stable BMI. Beginning with the physiological relationship, we can write stable BMI as follows:

$$BMI_i^* = BMI(F_i^*, E_i^*; H_i, N_i(BMI_i^*, \varepsilon_i, g_i)) \quad (1)$$

In the above, BMI_i^s refers to the individual's optimal (and stable) BMI. The equation requires that this BMI value be physiologically consistent with the (simultaneously chosen) optimal choices of food consumption, F_i^*, and energy expenditure, E_i^*, and with i's height, H_i, and her exogenous metabolic function, N_i, whose value depends on current BMI, an exogenous and permanent idiosyncratic metabolic shock, ε_i, and on gender, denoted g_i. All energy values are measured in the same units, such as kilocalories per day. By physiologically consistent we mean that, when individual *i* consumes (each day) the specified number of calories (F_i^*) and expends (each day) energy equal to the sum of endogenous (E_i^*) and exogenous (N_i) calorie-burning, her BMI will stabilize at the value BMI_i^*.[7] While there may be multiple physiologically consistent vectors BMI, F, E for a given individual, we assume that only one such vector maximizes (lifetime) utility given preferences, technology, and constraints. A somewhat arbitrary, quasi-reduced-form expression for optimal BMI is as follows:

$$BMI_i^* = BMI(P_f, Y_i, H_i, \varepsilon_i, \delta_i, \beta_i, g_i, \theta_T, \theta_S, \theta_C) \quad (2)$$

The expression indicates that the optimal BMI is a function of the relative money price per calorie of (undifferentiated) food, P_f; individual income, Y_i; individual height, H_i; the idiosyncratic metabolic parameter, ε_i; a vector of idiosyncratic taste parameters, δ_i, pertaining to food consumption, physical activity, and related life choices which may affect weight (such as smoking, labor force participation, and child-bearing); individual beliefs, β_i, about the health consequences of different BMI outcomes; a vector of technology parameters, θ_T, that affect the time cost of food preparation and acquisition, the

[7] $N_i(.)$ refers to resting metabolism, which we take to be an exogenous function of current BMI and a fixed idiosyncratic parameter. Because of its dependence on current BMI, the realized level of resting metabolism is, of course, endogenous. In equilibrium, the stable BMI can be reduced to a function of exogenous metabolic parameters (given food consumption and elective activity). We abstract from the fact that the metabolic parameters themselves can, to some extent, be influenced by changes in the individual's amount of lean (fat-free) body mass, such as might result from an increase in weight-training.

physical requirements of home and market labor, and the state of medical technology (which in turn may influence beliefs); a vector of social preference parameters, θ_S, consisting of a preferred weight (or BMI) or weight/BMI range and various social penalties for deviating from the preferred values; and a vector of parameters, θ_C, capturing relevant aspects of the physical environment such as climate, air quality, access to public transportation and access to different types of food. The last three parameters are not subscripted at the individual level in order to indicate that they are held in common at a higher level of socio-demographic or geographic aggregation, although the level may differ depending on the type of parameter.

We call this a "quasi-reduced-form" because each factor might in turn be reduced to lower-level, more properly exogenous, factors. For example, geographic features such as climate can be chosen via location choice, such that we ought to reduce physical environmental features to preference parameters governing these choices. Social preferences over physique are (in our view) endogenous in the long run, in addition to being potentially variable across social groups as defined by gender, race, and class. While past prices as well as the expected future paths of prices, income, and technological factors, such as a potential breakthrough in weight-loss technology, might influence the optimal weight value in a more complex model, we abstract from these concerns.

2.2 Empirical Models and Hypotheses

The parametric form of relationship (2) is unknown. In general, the empirical distributions of log BMI are closer to normal than the empirical distributions of BMI itself. However, it does not follow that the log BMI distribution is linear in its arguments, however convenient such an assumption may be. We estimate a number of different empirical models: those in which BMI is linearly separable in all its arguments, those in which log BMI is linearly separable in its arguments, and those in which BMI (or log BMI) is linear, but in which the effects of some different factors may interact with each other. We also examine logistic models of the binary outcome obesity of varying degrees of complexity. Our baseline model is as follows:

$$BMI_i = \alpha_0 + \alpha_1 EDUC_i + \alpha_2 INC_i + \vec{\alpha}_3 LOC_i + \alpha_4 AGE + \alpha_5 AGESQUARED + \alpha_6 YR + \vec{\alpha}_7 RACE + u_i \tag{3}$$

In expression (3), which we take to be gender-specific, education (EDUC) is intended to proxy for beliefs, β_i, and may also capture some portion of the individual preference factors, δ_i, and social preference factors θ_S transmitted within educational environments. Underlying the BMI choice model is a broader model of overall health determination. In such models it is typical to assume that individuals care about being healthy (Grossman 1972). In this framework, more educated individuals are more likely to achieve better health. According to this argument, more educated individuals should be more likely than less educated individuals to achieve a BMI that is within the medically optimal range, other things being equal. However, the effect of additional schooling on BMI will depend on whether uneducated people are expected to exhibit BMI values below the healthy range or above it. In the current context, involving a relatively inexpensive and abundant food supply, people in general are at greater risk of being overweight than underweight. Since schooling should help individuals to reduce that risk—by, for example, providing information about nutrition, the benefits of exercise, and the health impacts of overweight, or by its influence on literacy—we expect it to have negative effects on BMI. Since, on average, blacks have lower educational attainment than whites, the observed obesity gap between black and white women may be attributable to schooling effects.

Income (INC) captures individual economic constraints on the choice of consumption bundles, constraints which may affect both the quantity and quality of food consumption and therefore BMI. However, the direction of the relationship is not obvious prima facie. Assuming greater caloric intake increases well-being, and if food is more important than other goods—for example, if individuals are at risk of starvation—wealthier individuals are likely to consume more calories than others and, holding physical activity constant, achieve higher BMI. In conditions of abundance, when all individuals can afford to meet or even exceed their basic caloric needs, additional calories may reduce well-being on net by pushing BMI above some optimal target. In this case, we might expect no systematic effect of income on BMI. However, if achieving the optimal target is costly, for example because the environment (cheap junk food and sedentary jobs) tends to promote BMI in excess of the target, higher income individuals will be more likely to achieve it. In this case, we might observe a negative relationship between income and BMI. If this relationship holds on average among women, white women's higher income may explain their lower mean BMI and obesity incidence relative to black women.

The calendar year (YR) captures the state of technology, θ_T, which is assumed common across individuals in the U.S., and may also serve as a proxy for the national food price level and for public expenditures affecting BMI outcomes. Variation in such global factors will modify measured race effects only if they affect different race groups differently. Although the national food price level is observable, if measured annually it will be collinear with the year dummy and yet less informative, since the calendar year can proxy not just for current prices but also the past history of food prices. Age proxies for exogenous changes in metabolism, appetite, and body composition over the life-cycle and any variation in preferences that is linked with age; the inclusion of age-squared reflects prior information about the functional form of age's influence on BMI. Inclusion of age is therefore necessary to control for differences in the age distribution across ethnic groups.

Location (LOC) captures the factors, represented above by θ_C, specific to an individual's location, such as climate, population density, air quality, access to public transportation, food prices, and access to different types of food. These factors may impose constraints on the ability to achieve a given BMI by, for example, limiting exercise opportunities or lowering the cost of food acquisition. Since individuals choose location, this variable also proxies for preferences over the physical and social environment. Because different locations have different racial composition, location may help explain race differences in BMI. For example, if blacks are located disproportionately in neighborhoods in which fresh produce is expensive or even unavailable, we expect the residual race effect to fall once location is controlled for. In addition to using location to proxy for local food prices, in some parts of our analysis we can also include direct measures of local food prices. The error term, u_i, represents the sum of idiosyncratic contributions (e.g. the individual metabolic shock, tastes over food and exercise) not captured by observable factors, together with measurement error.

In the regression of the model in equation (3), letting white women (or, alternatively, white men) represent the omitted ethnic category, the coefficient on the African-American indicator represents the difference in mean BMI between black women and white women, holding the other factors in the model constant. The ethnic categories may proxy for a number of factors, which we can divide conceptually into two major categories: cultural and non-cultural. By cultural factors, we mean attitudes, beliefs, and values that exert a common influence on BMI within a given group, such as a body size ideal, attitudes toward exercise, preferred foods, and the force with which group norms are enforced. Non-cultural factors include, but are not limited to, physiological differences across racial groups, residual heterogeneity in individual incentives and constraints between white and African-American women, and the portion of measurement error that is correlated with these race categories. Therefore, the coefficient on the African-American variable represents an upper bound estimate of the influence of cultural factors specific to that group.

3 Data, Sample Selection, and Measures

The empirical analysis is conducted using data from the National Health and Nutrition Examination Survey (NHANES) and the Behavioral Risk Factor Surveillance System (BRFSS). The NHANES is a nationally representative survey conducted by the Centers for Disease Control (CDC). It contains information from medical examinations of weight, height, and other health measures, as well as self-reported weight and height values, for cross-sections of the US population. We employ data from NHANES I (1971-1974), (NHANES) II (1976-1980), NHANES III (1988-1994), and NHANES 1999-2004.[8] The BRFSS is a separate CDC survey that reports weight and height, desired weight, numerous

[8] Since 1999, the survey has been conducted annually, with statistics reported in two-year increments. Reported figures for NHANES 1999-2004 refer to the combined data, but figures can be broken out for 1999-2000, 2001-2002 and 2003-

health-related behaviors and demographic information based on telephone interviews of very large random samples (repeated cross sections) of the non-pregnant resident population 18 years and older in participating states of the US. We use data from 1998 to 2002.

We restrict the samples to individuals 25 years of age and older in order to minimize mis-measurement of ultimate educational attainment for younger participants. We also eliminate those over 74 order to ensure equivalent age ranges over time. From NHANES, we include individuals for whom the BMI measure is based on medical examinations as well as individuals for whom we observe only self-reported weight and height values. In order to include prices, we limit the BRFSS sample to the years 1998-2002 because of difficulties in establishing consistent links to CPI areas. The BRFSS samples also excludes non-metropolitan areas, again for purposes of linking price data to obesity data. We include women (or men) of all race groups, but report only discrepancies between whites (non-Hispanic) and African-Americans.

We calculate individuals' BMI from information on weight and height. We use observations in which participants' weight and height were measured by an examiner (NHANES only) as well as observations in which weight and height were self-reported ("interview-only" subjects); for the latter subjects, we correct the BMI values for self-reporting bias based on the bias observed in NHANES data for the same cohort among same-race-and-sex subjects for whom both self-reported and examined weight and height are available. [9] In the BRFSS, weight and height are self-reported over the telephone rather than in person as in NHANES, and no direct measurements are available. We correct for self-reporting bias in the BRFSS 1998-2002 data using the correction equations derived from the NHANES 99-04 data. However, there is reason to believe that self-reporting bias in the BRFSS is more severe than that in the NHANES (Villanueva 2001), such that corrected BMI values in the BRFSS are likely to understate true BMI on average. We investigate the robustness of the results to the possibility that

2004.

[9] We run race- and gender-specific regressions of examined weight against self-reported weight and its square, age, and age-squared, separately for NHANES III and NHANES 99-04, and do the same for height. The results from these regressions are available from the authors upon request.

the residual self-reporting bias in the BRFSS is race-specific.

In the NHANES, educational attainment is measured through self-reports of years of education, top-coded at 17+ years in the first three waves, where 16 years is an (imperfect) threshold indicating college completion. The 1999-04 data are top-coded at 13, however, such that those with just some college cannot be distinguished from those with a college degree or better. In order to compare education effects over time, we create consistent education categories across NHANES survey waves, defined as 0-11 years or “less than high school,” 12 years exactly or “high school,” and 13 or more years or “at least some college.” We use the same categories in the analysis of the BRFSS data. To check robustness, we run separate regressions, where possible, that include a fourth category for those with 16 or more years of schooling.

NHANES collects data on self-reported household income, rather than individual income, as a categorical variable. NHANES also includes a related variable based on household income, the “poverty income ratio,” which is recommended for comparing income effects across different surveys.[10] As recommended in the NHANES analytical guidelines, we collapse the poverty income ratio into three categories, ‘low’, ‘middle’, and ’high’, representing, respectively, individuals with household income up to 1.3 times the poverty threshold, between 1.3 and 3.5 times the threshold, and more than 3.5 times the threshold.[11] The BRFSS also includes self reports of household income, divided into 8 nominal categories. For the data years we use, the cutoff values are constant and therefore not adjusted for inflation. However, the quantiles implied by these cutoffs do not vary widely across the years 1998 through 2002.

We observe marital status in the NHANES data, which we collapse into categories for “married” and “not married.” We do not observe whether dependent children are currently present in the household. We proxy for children with a variable indicating whether or not the woman ever had a live birth. While

[10]The poverty income ratio is roughly standardized for inflation and takes into account household size, whereas the raw income categories are not easy to align consistently in real terms across surveys.

[11]Individuals up to 1.3 times the poverty line are eligible for food assistance programs and thus we might expect categorical differences in outcomes across this divide.

the latter is a weak proxy, age and marital status should also help predict the presence of children. As a measure of employment status for NHANES, we use responses to a question that asks whether the individual engaged in market labor during the past week (or two weeks, depending on the survey wave). We define a "yes" response as "employed" and a "no" response as "not employed." The not employed category includes several types of people: those looking for work, those temporarily laid off (such as seasonal workers), and individuals not in the labor force. We also use measures of physical activity level and smoking behavior. In the NHANES, the activity measure is a self-reported value for whether the individual is more active, equally active, or less active than "peers of the same age." Because the nature of the physical activity was not specified, it may capture both leisure- and work-related activity. In NHANES, we identify as smokers those who reported "currently" smoking either every day or on some days, and all others as non-smokers.

NHANES has limited geographic information and the observed data vary somewhat across surveys. In NHANES II and III, we observe an indicator of the census region, either northeast, south, midwest, or west. In these same surveys we observe a binary indicator of whether the individual lives in a metropolitan area with population one million or greater. Geographic variables have not yet been released for the 99-04 data. We include these geographic indicators when available in our most comprehensive regressions, reported below. The BRFSS data includes specific MSA (metropolitan statistical area) codes, which provide a finer indicator of geographic location than does NHANES. We also link a measure of MSA-specific food prices–the food Consumer Price Index (CPI)–to the BRFSS data.

We use the BRFSS data to further corroborate the large and significant unexplained differences in mean BMI and obesity risk between black and white women in the United States. The BRFSS includes additional variables not included in the NHANES surveys, most notably finer geographic identifiers, which can be used both to better control for geographic factors and to link local food price data to the BRFSS. In some survey years, self-reported values for "desired weight" are included, and we use these in the discussion of race-specific social preferences further below. Although the data consist of a far greater number of observations, they extend back only to 1986 (and as recently as 2005), and desired weight was observed only sporadically within that period.

4 Main Results

We estimate the above equation in stages in order to determine the extent to which inclusion of additional variables alters the magnitude of the race residual. After an initial exercise in which we examine the impact of education on BMI and on residual race effects in the NHANES data, we expand the list of controls to better capture the factors present in the model above, and demonstrate further robustness of race differences within both NHANES data. Because the controls are inevitably incomplete, and the causes of the race effect potentially multiple, we then discuss the validity of various explanations for the residual race effects, focusing alternatively on economic, biological, and sociocultural factors, drawing on a combination of theory and additional evidence.

In the tests using NHANES, we cannot control for individual calendar years. Given the long time span of the data across surveys, we estimate the model separately for each survey wave, pooling the 1999-2004 data together as recommended in the NHANES analytical guidelines (National Center for Health Statistics 1996). Complex survey design is accounted for, in both surveys, using Stata's "svy" commands, which weight the data appropriately and account for various levels of clustering in the survey design when producing standard errors.

4.1 Influence of Educational Attainment

Results of the linear regression (using three education categories) are in Table 2.[12] First, observe that the difference in mean BMI between white and black women is highly significant in each regression. The magnitude of this difference does not change much between waves I, II, and III, although an increasing trend is indicated (not shown). The effect jumps significantly in the 99-04 data, a result that

[12] We also run linear regressions against log BMI to account for non-normality of the BMI distribution. Significance and magnitude of effects are not substantively different, so we report only results using BMI as dependent in the linear models.

is surprising in light of the fact that disparities in educational attainment have declined over the past 30 years. The effect for NHANES 99-04 of approximately 3.6 BMI units represents a difference of 17.3 pounds for a woman of average height (1.62 meters or 64 inches, which is roughly the same for black and white women). This difference is even greater than the 3.1 unit difference in mean BMI in the corresponding raw data.

The effects of education, while mostly significant, exhibit some noteworthy changes over time. In both NHANES I and II, we observe significant negative effects of high school completion (relative to non-completion) on BMI, and even larger negative effects of having some college exposure. In NHANES III the effect of high school becomes insignificant (as well as much smaller as a point estimate) and remains so in NHANES 99-04. The effect of "some college," while significant in each survey wave, becomes progressively smaller over time. In the regressions that break out the most educated individuals into a "college or better" category, we observe a significant difference between those with only some college and those with a degree. While the effect of "some college or better" was -1.76 units for NHANES III, this breaks into effects of -1.05 for some college and -2.57 for college or better, respectively. However, the effects of college or better in NHANES III are lower than in previous survey periods.[13]

While we observe a persistent and significant fixed effect on mean female BMI of being African-American after controlling for educational attainment, there may be differences in the meaning of the education categories by race that might help explain the race effect in the above model. Such differences could consist of heterogeneity in the content or quality of education across race groups at the same level of attainment, such as might result from racial segregation in schools, or differences by race in the average educational attainment of individuals in the top-coded groups–"some college or better" in the first specification and "college or better" in the second. To control for such differences

[13] The declines in the (negative) impacts of education on mean BMI occurred at the same time as occurred large increases in educational attainment across all race groups. The changing effects of education could reflect the effect of changing racial composition within education groups in the case that the impacts of education on BMI differ by race, even though we do not observe significant interaction effects between race and education. However, there is some indication, based on the point estimates, that the effect of education has declined for both race groups and possibly by more for blacks.

we add interaction terms between race and education to the model. As seen in Model 2 in Table 2, these terms are never significant. Therefore, the fixed race differences in BMI in the models without interactions would not appear to be driven by differences in attainment between the top education groups of each race, nor by differences in the effect of high school completion on BMI between black and white women.

However, the fixed difference could reflect a difference in educational treatment between whites and blacks that affects all education groups equally, perhaps a difference that occurs in grades K-11 and has a permanent impact. If this were the case, we should expect a similar difference to arise between black and white men, since there is no reason to expect that any difference in formal educational treatment at this level between blacks and whites would also differ by gender. (This is not to say that informal socialization should not be expected to differ by both race and gender, but if so such differences in socialization point to an explanation based on sociocultural ideals.) However, the only significant difference in mean BMI between black and white men controlling for education, in models both with and without race-education interactions, occurs in NHANES III and indicates *lower* BMI for black men–see Table x. Since it is not readily apparent why the same difference in educational treatment would have the opposite effect on men as women, we conclude that neither differences in education treatments nor in factors proxied by educational attainment can explain the race differences in mean BMI among women in the NHANES data.

The results using log BMI as dependent variable involve no differences in which coefficients are significant, and the trends in the effects of education follow those from the BMI-linear model. The estimated coefficients indicate that, controlling for educational attainment, mean BMI among black women was roughly 8.6% greater than mean BMI among white women as of NHANES I; as of NHANES 99-04 this difference amounted to approximately 12% of white female BMI. Estimates from intermediate survey periods fall within this range. If anything, these results indicate an even greater growth in the mean BMI gap over time do the models with BMI as the dependent variable.

We also run logistic regressions of obesity (defined as BMI greater than or equal to 30) against the same explanatory factors for the same group. Table 3 shows the results–expressed as odds ratios–of logistic regressions, with obesity as a binary dependent variable but using the same explanatory variables. In the model without interactions between educational attainment and race, the obesity odds ratio for blacks relative to whites hovers between 2.0 and 2.2 across survey waves, a value only marginally smaller than the raw odds ratios in data. Similar to the linear model, attainment of "some college" education has resulted in successively less reduction in the odds of obesity over time and high school education ceases to have a significant impact on obesity odds in NHANES 99-04.

In the logistic model with race-education interactions, the odds ratio for African-American women appears to decline between NHANES II and later survey periods, a result that indicates greater relative obesity growth among the least educated whites than among the least educated blacks between the earlier and later periods. We observe one significant interaction term: in the 99-04 data, the negative effect on obesity risk of some college education is significantly weaker among blacks than whites. As hypothesized above, this may be attributable to differences in the average educational attainment of blacks relative to whites within this group, since the highest degree achieved is unobserved, and/or due to differences in the content and impact of a given level of education among black women relative to whites. However, as in the linear models above, we find a significant difference in obesity odds between the least-educated black women and least-educated white women, but no significant difference in the odds of obesity between white and black males in the lowest education class. This finding works against an explanation for race differences in female obesity risk based on differences in education quality or content in the primary grades or early-high-school years.

4.2 Impact of Income Differences

In cross-sectional regressions of recent (aggregate U.S.) data, such as in Chou et al (2004), a significant negative coefficient has been observed for the effect of income on BMI. However, interpretation of estimated income effects must proceed with caution because there is considerable evidence that higher BMI results in lower female wages and wealth, lower spousal income, and reduced occupational status (Baum and Ford 2004, Conley and Glauber 2005, Cawley 2004, Averett and Korenman 1996, Bhattacharya and Bundorf 2005). Competing explanations for BMI-related wage penalties include BMI-related productivity differences, BMI-related health insurance costs, and appearance-based discrimination. If the race effect disappears when we include income, we should not conclude that income variation explains obesity differences, but we can infer that the resulting race residual represents unobserved factors correlated with both race and BMI but not also with household income. Income also determines the opportunity cost of time, which is a factor in the full cost of home food preparation, non-home food acquisition, and leisure-time exercise.

Observe first the impact of including the income measures in the model without interactions–that is, including education measures and income measures but not allowing interactions between either race and education or race and income. Relative to the model that controls for education and age, the model that also includes income results in smaller estimated race effects. The difference in the point estimates of mean BMI between black and white women is reduced by anywhere from .19 units (NHANES II) to .44 units (NHANES I). However, none of these changes is significant. In the most recent survey the estimated mean BMI gap is 3.46 units, controlling for education and income. The trend of the mean BMI difference is still increasing, in either absolute or percentage terms. The growth in the absolute race effect is significant between NHANES I and NHANES 99-04 as well as between NHANES III and NHANES 99-04 (see Table 2), Models 3 and 4. R-squared values improve by about one percentage point or less with the addition of the income measure, although within each model R-squared values are decreasing over time.

The effect of being in the highest income category relative to the lowest is negative, significant, and roughly constant across all survey periods. The effect of being in the middle income category relative to the lowest is initially significant and negative, although weaker than the effect of high income), but becomes insignificant in the 1999-2004 data (see Model 3 in Table 2). The significance of the education effects is not altered relative to the model without income. However, the magnitude of the negative impacts of education on BMI are reduced when income is included. Not surprisingly, this result indicates that education proxies partially for income but that income is associated with BMI differences even after controlling for educational attainment. In linear models including interactions between race and income, we observe no significant differences in the impact of higher income on BMI between black and white women. Rather, the same fixed race difference appears to prevail across all income-education classes (see Model 4 in Table 2).

Results of the logistic regressions including income are qualitatively similar to those from the linear regressions (see Table 3). One difference of interest is that the (negative) effect of middle income relative to low income on obesity risk becomes insignificant as of NHANES III and remains so in the 1999-2004 data; being in the highest income group significantly lowers obesity risk, and by roughly the same amount, across all survey periods. In the most comprehensive models (but excluding interaction terms), the estimated odds ratio of obesity risk ranges from a low of 1.51, for NHANES III, to a high 2.27, for NHANES II, but the differences in the estimates across surveys are not significant. In a logistic model with race only, the corresponding odds ratio estimate is 2.01 for NHANES 99-04 and the confidence intervals of this estimate overlaps with that for the more comprehensive model.

4.3 Physical Environment, Opportunity Costs of Time, and Individual Tastes

As stated above, aspects of the built environment (and natural) environment, such as climate, roads, sidewalks, parks, population density, public transportation, and other amenities (and hazards) may exert significant impacts on BMI insofar as they either promote or hinder physical activity. Of course, selection into geographic locations (and adaptation of the built environment to local preferences) makes it difficult to identify treatment effects of the built environment. Still, if preferences over foot transit versus auto transit, for example, are responsible both for one's choosing to live in Boston rather than Birmingham as well as for one's obesity status, and if these preferences are correlated with race, then location serves as a proxy for unobserved preference differences that help explain race differences in obesity status.

Similarly, geographic variation in food supply and demand, resulting in variation in food prices and access to different types of foods, could be correlated with geographic variation in racial composition. These food market conditions may predict obesity rates in the surrounding population, either for causal reasons or because they reflect food preferences. Geographic controls will capture any portion of race effects on BMI and obesity status that are associated with fixed differences in food market conditions at the given level of aggregation. Including these controls, then, may result in a conservative estimate of race effects, since the existence of race-specific preferences over the built environment and race-specific food preferences would seem to point toward social interactions in preferences along racial lines. We take up the discussion of social interactions at length in Section 7.

Although we observe significant residual race differences after controlling for household income relative to the poverty line, additional *unearned* income (for example, spousal income) may be more likely to lower BMI than additional self-earned income, since the different types of income may be associated with different opportunity costs of time.[14] If, on average within each income group, a greater share of black women's household income is self-earned than is white women's, it could be costlier for black women to exercise and to prepare healthy meals. Single parents are also likely to face higher opportunity costs for BMI-lowering activities than would married women with no children and black women are more likely to be single parents. Therefore, race differences in marital status, presence of children in the household, and employment status might help explain BMI and obesity differences between black and white women that operate through differences in individual earned income.[15]

While physical activity and smoking are known to influence BMI in a proximate sense, each depends on underlying individual constraints (e.g. time costs), preferences (e.g. taste for exercise), and

[14] This hypothesis may help explain why the effects of income on BMI and obesity risk are different for men than women, on the presumption that men's additional household income is more likely to represent added earned income than women's. For example, among men, income above 3.5 times the poverty line exerts no significant impact on either mean BMI or obesity risk relative to men in lower income groups.

[15] Women's labor force participation has been cited as a contributing factor in the prevalence of overweight among children and adolescents (Anderson and Butcher 2003) and has been associated in the aggregate with rising obesity rates (Bleich et al. 2007).

beliefs and may also depend on social preferences. These choices might also be influenced by BMI itself. We include the physical activity measure and the smoking indicator not to identify treatment effects but to capture heterogeneity in unobserved preferences and constraints. If including the exercise measure, for example, were to significantly reduce race differences, we would then have to explain the race differences in unobserved factors predicting both exercise and BMI. We also include height, measured in inches, which enters BMI determination mechanically (in the denominator) and which also affects resting energy expenditure. Lastly, we include a binary indicator of whether the individual was born in the United States because this might be expected to proxy for differences in individual and social preferences that influence BMI.

Table 4 shows results of the comprehensive linear and logistic regressions for women for NHANES III.[16] The main results of interest are the estimated coefficient on the dummy for African-American. In the model of mean BMI, the coefficient on the race effect is highly significant in each regression, with a value of 1.99 for NHANES III (see Table 4) and 2.11 for 1999-2004. These point estimates are lower than in the less inclusive models, indicating that the added controls may explain some of the race difference in mean BMI for these surveys. However, the 95% confidence intervals overlap and the remaining differences are still of considerable magnitude: a difference of two BMI units amounts to 11.62 pounds on the frame of a woman of average height (5 feet, 4 inches tall). The qualitative effects of education and income are the same (in terms of direction and significance) as in the previous models, although for both NHANES II and III the point estimates of the effects of education and income are smaller in magnitude, but not significantly so.

Among the additional included factors, the activity variable and the smoking variable have the greatest effects and are uniformly significant, while the geographic variables, marital status, non-native-born status, and experience with child-bearing are never significant. Unemployment has a marginally

[16] We ran similar regressions no NHANES II and 99-04 but the variable list is most comprehensive for NHANES III, so the table reports only NHANES III results. We discuss results from all three survey waves below. We omit results of regressions including interactions between education and race and income and race since interactions are not significant and the fixed race effects are not significantly different than in models without interactions.

significant (8.5% level) and positive effect of .65 units on mean BMI in NHANES III. Height has a significant (small) negative effect only in NHANES II. The excluded activity category indicates a reported activity level deemed “roughly equal” to that of her same-age peers. In NHANES II and III the effects are asymmetric, such that very active or more active individuals have lower BMI than the omitted group, but the difference is not as great as that between the moderately active group and the least active group. The point estimates are roughly twice as great in either direction in NHANES III relative to NHANES II. In the most recent survey, the effects are greater still and the effects are more symmetric. Based on the point estimates, smoking is found to lower mean BMI by around 1.4 units in both NHANES II and 99-04 and by 1.88 units in NHANES III. The results offer evidence that higher BMI among black females may be partly attributable to lower physical activity levels and lower smoking prevalence.

The logistic regressions yield a similar pattern: the race differences in obesity odds appear greater for NHANES II and 99-04 than for NHANES III, although again all the confidence intervals overlap. The most recent data yields an odds ratio for obesity among black women relative to whites that is not significantly different from the odds ratio in a regression against race only. Therefore, the controls go farther in explaining race differences in mean BMI than they do race differences in obesity rates; since physical activity, at least, has strong effects on obesity odds ratios analogous to its effects on mean BMI, we might infer that physical activity differs less by race among obese women than it does among non-obese women. Consistent with our observation that BMI values between black and white women diverge further–relative to the gap at the mean–at higher percentiles of their respective distributions, the results also indicate that differences in mean BMI alone do not explain differences in obesity rates.

4.4 Additional Tests using the BRFSS: Effects of Location and Food Prices

In a number of recent papers, the rise of obesity has been linked to supply-side-driven declines in food prices, both in list prices and preparation and travel costs.[17] Therefore, we might ask whether exogenous food price differences between blacks and whites might explain the consistent cross-sectional differences in the female BMI distributions. However, we cannot imagine a source of exogenous variation in food prices between whites and blacks other than geography, and any such price variation would have to be gender-specific to explain the stylized facts. Therefore, we argue that including region and year fixed effects in the BRFSS regressions ought to be sufficient to control for any contribution of exogenous average food price differences–at the given level of aggregation–to persistent BMI differences between black and white women. As a second-order consideration, however, we can ask whether possible differences in regional price movements faced by blacks and whites–induced by differences in their locations–may have contributed to fixed race differences in BMI (among women and/or men). Including regional prices (using MSA codes, food CPI data can be linked to our region identifiers in the BRFSS) while controlling for region fixed effects helps isolate exogenous price variation, while year fixed effects ensure that price effects are not simply reflecting aggregate trends in prices and obesity. However, since there may have been unobserved, region-specific demand shocks that affected regional food prices and BMI values, we do not identify price treatment effects with certainty.

As in the previous regressions, we include categorical measures of educational attainment and income, as well as age and age-squared, an indicator of regular vigorous physical activity, race (grouped as white, black, Hispanic, and other), 28 MSA groups, and three different (MSA-by-year) measures of food prices: food at home CPI, the overall food CPI, and the overall food and beverage CPI. Table 5 shows results of logistic regressions with obesity (BMI greater than or equal to 30) as the dependent variable. The odds ratio on African-American with just race, age, and age-squared in the regression is 2.45. As we add controls the value gets progressively smaller, but settles at 2.02 with the full list

[17] Food prices played a role in frameworks of Lakdawalla and Philipson (2002), Philipson and Posner (1999), Burke and Heiland (2006, 2007), Cutler et al. (2003), and Chou et al. (2004).

of controls. Inclusion of education, year, and location effects each reduce the odds ratio by only very small amounts; inclusion of income controls has the greatest effect on the black-white odds ratio and the exercise variable has the second-largest effect. Price has no effect on the black-white odds regardless of which measure we use. The magnitude of the controlled odds ratio is strikingly similar to that in the most inclusive logistic regression using NHANES 99-04 data.

Effects of education and income are, for the most part, qualitatively similar to those observed in the NHANES data. One exception is that we observe evidence of non-monotonic income effects when observing income in finer gradations–income has positive marginal effects on BMI at low levels of income and negative effects at middle and upper income levels; the same is true for men but the income level at which the relationship switches is much higher for men. The location indicators (coefficients suppressed) point to significant regional differences in mean BMI, despite the fact that such differences do not account for race differences. Prices, in either the linear or logistic model, have significant but only very small negative effects on mean log BMI or obesity risk. Effects of national price changes are embedded in year fixed effects, which are significant and positive, so we should not take the location-specific price effects as the full measure of price impacts on BMI.

In regression against log BMI, we find that African-American women have mean BMI about 14% greater than that of whites, where the difference is highly significant. Taken as a percentage of mean BMI for white women for NHANES 1999-2002, that amounts to about 3.8 BMI units, a value that resembles the race effects observed in regressions involving NHANES 1999-2004 and a similar list of controls (although effects are lower in the more complete NHANES model). Measurement error differences by race may contribute to this effect, however, since we find that black women in the NHANES tend to self-report higher BMI values than white women with the same actual BMI value. Although our self-reporting-bias corrections are race-specific, these are derived from NHANES data and so may be insufficient when using BRFSS data (Villanueva 2001).

5 Explanation of Race Differences in Obesity based on Differences in Unobserved Economic Incentives

The included controls are obviously inadequate to rule out the possibility that race differences in obesity are driven by race differences in various unobserved economic incentives affecting the BMI outcome. For example, the increasingly sedentary nature of work has been cited as an important factor in rising obesity rates (Lakdawalla and Philipson 2002) during the past century. Accordingly, we should consider whether differences in the nature of work (where occupation choice is deemed at least partly exogenous in BMI) performed by black and white women might, by resulting in different levels of energy expenditure, explain the persistent differences in their respective BMI distributions. However, at least four pieces of evidence argue against this explanation: (1) differences in sedentariness due to geography have already been controlled for in BRFSS results, (2) self-reported differences in physical activity have already been controlled for in the regression analysis, (3) historically, black women have been disproportionately represented in more physically demanding jobs than white women (R.E.B. Lucas 1974)[18], and (4) occupational segregation has declined dramatically since the 1940s (King 1992), a fact that should have promoted convergence of BMI outcomes by race if work-related physical activity were a major factor in race differences.

In the Lakdawalla and Philipson (2002) story, declines in the caloric demands of (market and non-market) labor contributed to rising BMI because caloric intake did not decline by enough (or actually increased) to compensate. However, physically intensive labor could, by building muscle, contribute to higher BMI if caloric intake can keep up. In addition, if it comes in the form of lean mass, greater body mass could be seen as an advantage in physically demanding jobs. Racist labor market segregation (and, looking farther back, slavery) could, therefore, have contributed to greater BMI, although not necessarily up to the level of obesity, among African-Americans than whites during a period of lower

[18]Lucas (1974) reports that as of the 1966 CPS, black women were significantly more likely than whites to have jobs requiring a high level of strength, requiring climbing or stooping, and involving work outdoors.

average BMI. We believe that the long-term history of racial segregation, in social life and in the workplace, did and still does play an important role in shaping race differences in BMI outcomes as well as racial perceptions of physical mass as either an asset or a liability. This line of thinking will enter our discussion of social preferences below.

We must also consider the influence of home production's physical demands, demands that affect women regardless of labor force status. Black women, being on average poorer than whites throughout the period under consideration, should have had less access to labor-saving appliances than white women; such differences, ceteris paribus, also predict lower obesity rates for black women than whites in levels as well as convergence of BMI distributions as technological access converged, both of which are contrary to our observations.

The indicator of employment in the NHANES data is likely to be a weak measure of labor force participation, a factor that has been linked to increases in aggregate obesity rates, possibly through its effect on demand for calorically dense convenience foods and on the opportunity cost of leisure-time exercise. As further evidence that female race differences in obesity are not likely to be explained on the basis of higher labor force participation among black women, we note that black women's labor force participation rate is lower than that of white women's, and has been since the early 1980s (Aldridge 1989). Furthermore, while aggregate female labor force participation and aggregate female obesity in the U.S. appeared to move (upward) together between 1986 and 1996 (based on BRFSS obesity statistics and labor force information from the Current Population Survey), since that time female participation has levelled off or declined while female obesity (based on the BRFSS data) continued to increase through 2003, and through at least the year 2000 in the NHANES data. The obesity-employment patterns for black women versus white women are even more surprising in light of Ruhm's (2000) observation that obesity tends to increase (and physical activity decrease) cyclically as unemployment declines.

Averett and Korenman (1996) and (1999), Baum and Ford (2004), Cawley (2004), and Conley and Glauber (2005), examine economic and social penalties associated with obesity. Cawley (2004) finds significant wage penalties associated with obesity among white women, but not among black women.

Averett and Korenman (1999) find significant negative effects of obesity on white women's marriage prospects and spousal income, but little to no effect of obesity on black women's marriage prospects. Baum and Ford (2004) do not examine race differences but find that obesity-wage penalties do not differ in percentage terms across industries. There is disagreement as to the causes and magnitude of obesity wage penalties across the studies: they could reflect underlying differences in productivity that are either caused by obesity or caused by a third factor that also leads to obesity, or they could reflect discrimination on the part of employers. In the case of marriage prospects, appearance concerns are likely to be more salient, but obesity could also be a signal of potential earnings and potential fertility. The presence of such penalties creates an incentive for individuals to maintain a normal (or at least non-obese) BMI. The fact that such penalties appear smaller or non-existent for black women suggests that the incentive to maintain a non-obese BMI may be weaker for black women in these dimensions. Appealing to such a difference in incentives to explain differences in obesity, however, begs the question of why the penalties might differ by race in the first place. As we argue below, we believe that the pattern in penalties itself reflects race-specific social preferences over BMI that both contribute to and are reinforced by the observed race-obesity patterns. These social preferences also have potential implications for the productivity effects of obesity on black versus white women, as we discuss below.

6 Explanation of Race Differences in Obesity based on Physiological Differences

The biomedical and epidemiological research on obesity prevalence has naturally looked for physiological and genetic explanations for variation in prevalence across groups. One factor that has received considerable attention is energy metabolism or calorie burning, an important component of the energy balance equation. Basal metabolism, defined as the energy expended in maintaining basic body functions at rest, is very expensive to measure, however, so the quantity of subjects in any given study has been relatively low. Still, a group of controlled studies have found systematically lower values for both resting metabolic rates and total energy expenditure for black Americans (women and men) as compared to white Americans, even after controlling for factors–most notably lean body mass and physical activity levels–known to be the primary determinants of such expenditures (Martin et al. 2004, Sharp et al. 2002, Weyer et al. 1999, Carpenter et al. 1998, among others). Can differences in exogenous metabolic endowments account for the persistent weight differences between black and white American women? Possibly, but this explanation should also predict a large obesity gap between black and white men. In the NHANES data we observe no significant differences in either mean BMI or obesity risk between black and white men. In the BRFSS data, we do observe significantly greater obesity risk among black men, but the magnitude of the difference is considerably smaller than that for women. In addition, not all studies agree with the finding of a significant metabolic difference between African Americans and white Americans (Luke et al. 2000, Nicklas et al. 1997). We conclude that, at the very least, a fixed difference in resting metabolism is not a sufficient explanation.

While excess BMI has been strongly correlated with negative health outcomes and premature mortality (Flegal et al. 2005, Olshansky et al. 2005), the association is imperfect for a number of reasons. Excess adiposity or fatness, rather than excess lean mass, is the true culprit in the link between high BMI and disease, but the body mass index treats all body mass, fat or lean, equally.[19] BMI is used to define overweight and obesity, rather than body fat percentage or waist circumference, because it is easy to measure and sufficiently correlated with both adiposity and disease risk to make the recommendations appropriate for most people (Troiano et al. 1996). However, there is evidence that, for a given BMI value, the expected percentage of body fat is lower among blacks (both male and female) than whites (Cawley and Burkhauser 2006). Cawley and Burkhauser (2006) argue that, if female obesity is defined as 30% or greater percent body fat rather than a BMI of 30 or greater, the difference

[19]Even this statement is an oversimplification, since excess visceral or belly fat appears to entail greater health risk than excess fat in the legs and buttocks.

in obesity rates between black and white women in the NHANES III sample (ages 18-65) is reduced dramatically–according to their calculation, it falls from a gap of 11 percentage points to 5.2. Using a 25% body fat obesity threshold for men, they find significantly lower obesity rates, by 16.3 percentage points, among black men than whites. In light of these results, we would expect the marginal disease risk associated with higher BMI to be smaller for blacks than for whites. If so, we could argue that the health cost of higher BMI is lower for blacks and that they rationally "consume" more of it. Consistent with this prediction, there is evidence that the reduction in life expectancy associated with obesity is lower for black women than for any other group (Olshansky et al. 2005).[20]

Before testing for race differences in the health risks associated with higher BMI, it should be noted that defining female obesity based on the 30% body fat threshold is problematic since there is no scientific agreement as to what level of body fat percentage should define obesity. In addition to 30%, we have seen suggested thresholds of 33%, 35%, and even 39% in the literature (Gallagher et al. 1996, Gallagher et al. 2000). The NHANES III obesity rates computed by Cawley and Burkhauser based on the 30% threshold are stunning: 69.33% for white women ages 18-65 and 74.56% for black women in the same age range. These figures exceed by a significant margin even the proportions of *overweight* as of NHANES III based on the BMI overweight criterion. In addition, there is the potential for considerable measurement error in detecting body fat. NHANES III uses bioelectrical impedance analysis (BIA) to detect body composition, which is less accurate than some other, more costly methods. Although Cawley and Burkhauser use equations (estimated by Sun et al. 2003) based on a sophisticated "4-compartment" (4C) reference model, conversion equations can be sensitive to the given subject pool and other methodological factors. A study by Gallagher et al. (2000) derives predictive equations for body fat percentage based on BMI, age, race, and sex, also based on the 4C model. Using these equations (which are race-specific, as are those used by Cawley and Burkhauser)

[20]This assertion is subject to doubt, however, since the measure on which it is based is neither a marginal effect nor truly comparable across groups. The number represents the average life expectancy gain that would occur if all obese members of a given group were to reduce their BMI to a value of 24 and achieve the life expectancy of others in the same group with a BMI of 24.

and adopting the 30% body fat threshold, we calculate an obesity gap between black and white women ages 25 to 74 of 4.01 percentage points for NHANES III and 8.58 points for NHANES 99-04. Although these gaps are indeed much smaller than the corresponding BMI-based gaps of 15.7 and 19.2, the obesity gap becomes larger at body fat thresholds of 33% and 35%, respectively: these gaps are 7.15 and 8.21 for NHANES III and 12.83 and 13.22 for NHANES 99-04. While the body fat criteria do result in lower measured obesity gaps, the extent of the reduction is sensitive to the fat threshold chosen and appears less dramatic in the most recent data.

Using NHANES III data on (self-reported) incidence of diseases associated with obesity, we can test whether the marginal effect of BMI (or obesity) on disease risk is lower for blacks than whites. We restrict the sample to adults 30 and older to avoid censoring of disease incidence among younger subjects. Using diabetes as the dependent variable, we run a logistic regression against BMI, race, an interaction term between race and BMI, and the income and education categories employed above. We find a marginal odds ratio on BMI of 1.086 (highly significant) and a significant coefficient on the interaction term that indicates that higher BMI raises diabetes risk by significantly less for black women than for whites. This effect does appear to be explained by underlying differences in body fat percentage, because when we substitute body fat percentage for BMI (and a corresponding interaction term), the interaction is no longer significant–that is, higher body fat percentage imposes the same marginal risk of diabetes regardless of race. The pattern of results is similar when we let the dependent variable be defined as the presence of any one of four obesity-related diseases: congestive heart failure, hypertension, diabetes, or heart attack (acute myocardial infarction).

We run similar regressions substituting the binary explanatory variable obesity and an interaction term between obesity and race. When we define obesity using the standard BMI criterion, the effect of obesity on diabetes is not significantly different for black women; however, the effect on combined disease risk is significantly lower for black women. When we use instead the 30% body-fat threshold for obesity, the interaction term for the combined disease risk becomes insignificant; for diabetes alone the odds ratio on the interaction term is actually greater than one and significant. Despite evidence that

BMI may entail lower marginal disease risk among black women, body fat appears to impose similar, if not elevated, risks among black women. Therefore, the observed risk patterns may explain some portion of higher observed BMI among black women, but they do not explain higher observed body fat percentage and obesity rates (based on body fat percentage) among black women.[21]

The patterns do give reason to believe, however, that the health risks associated with obesity may be obscured for black women, since both obese and non-obese black women (and black men) have elevated risks of diabetes, hypertension, heart disease, and other conditions, as well as lower life expectancy than white women. In assessing the risks of disease, race may be overly salient in the sense that individuals may perceive that the risks are fixed biologically. Although race looks like the strongest common factor in the elevated disease risk of obese and non-obese black individuals, it is likely that non-obese blacks have elevated disease risks for different reasons (such as higher smoking rates) than do obese blacks. Alternatively, underlying factors, such as poor nutrition, may be similar but still within subjects' control. Again, however, this line of reasoning leaves the gender specificity of the obesity gap unexplained, since black male disease risk is also less strongly linked to obesity than are the risks for white men.

7 Explanation of Race Differences in Obesity based on Differences in Body Ideals and Body Perception

Because BMI is an aspect of appearance, choices related to BMI depend not just on health considerations but also on aesthetic preferences over body size and shape, the preferences held by the individual herself as well as the preferences of family members, potential mates, friends, and employers. That social preferences over shape and size exist may seem an innocent assertion, but the nature of such preferences, their origins and evolution, and their behavioral consequences are matters of considerable

[21] For more on the association between obesity and disease risk, see Costa-i-font and Gil 2005.

complexity. We conceive of such preferences as consisting of a combination of a physical ideal–we simplify this to mean the size considered most desirable or beautiful–together with punishments for deviating from the ideal, where the severity of punishment may depend on the realized distribution of physiques in the relevant population.[22] Therefore, the ideal and the realized modal or average size may diverge considerably. A considerable body of evidence suggests that ideal body sizes are historically contingent, gender-specific, and not necessarily coincident with standards based on optimal health.[23]

Physical ideals are expressed in–or, some would argue, produced by–popular media such as films, advertisements, magazines, visual art, and in the selection of celebrities or icons. As a rough definition, we would put forth that an ideal can be ascertained when the dominant cultural imagery tends to portray (and associate beauty with) only a small slice of the true size distribution. Researchers have also measured ideals by offering to subjects a menu of drawings of male or female adults, corresponding to different BMI values, and asking them to identify the picture that represents the societal ideal for either sex (Massara and Stunkard 1979). In some studies, people were asked also to identify also their personal ideal, the range of sizes they would consider "socially acceptable," the size that matches their own, and the size most preferred by the opposite sex (Kemper et al. 1994). Reported societal ideals tend to be strongly correlated across individuals exposed to similar cultural imagery, although reported personal ideals tend to exhibit greater variance and "acceptable" ranges may be quite broad. We speak of these standards as social preferences to capture the assumption that most people in a given society are aware of a common ideal and have internalized it to one extent or another. The female ideal BMI as embodied in Playboy centerfolds between 1980 and 2000 was in the neighborhood of 18 to 19, well below average and straddling the underweight threshold of 18.5 (Voracek and Fisher 2002).

However, there is a large body of evidence that finds that, on average, adult African-American

[22]While we have referred to "social norms" for body size in our previous work, there we had in mind a social conception of "normal" weight rather than an ideal, and we hold that the content of norms and ideals may diverge. Here we focus specifically on ideals and stigmatization for deviation from the ideal. We are not the first to adopt these terms and definitions–see Garner et al. 1980.

[23]See, for example, Stearns 1997, Voracek and Fisher (2002), Graham and Felton (2005), Garner et al. (1980), among others. On the other side of the debate, some sociobiologists claim that, at least in terms of proportions, standards of female beauty are genetically hard-wired and therefore fixed (Singh 1993).

females recognize a higher ideal BMI than white women.[24] In some studies, both black men and black women indicated higher values for ideal *female* size than did white men and white women. We calculate the average estimate of this ideal to be a BMI value between 23 and 24, about three units greater than the average white ideal identified in the same studies.

Consistent with the evidence of higher ideal BMI among black women, we find in the BRFSS that the self-reported *desired* body mass index of African-American women is substantially greater on average than that for women of other racial or ethnic groups, in particular for white women (see Figures 1 and 2). Interestingly, we do not observe such a discrepancy between white men and African-American men (see Figure 3). (Although desired heights were not elicited, we compute desired BMI using self-reported desired weight and bias-corrected self-reported height.) As a more meaningful test, we regress the difference between observed (bias-corrected) BMI and desired BMI against BMI, age, age-squared, race, education, marital status and smoker status. The greater the difference between observed BMI and desired BMI, the farther is the individual from her desired size. We find a significant negative effect for African-American women of 1.04 (standard error 0.026) units. If the gap between actual and desired BMI can be taken as an index of body dissatisfaction, the results indicate that black women are less dissatisfied with their size than white women of the same size, age, and education class.

In addition to evidence of a racial divide in physical ideals, there is evidence that the social punishments for overweight and obesity are less severe for black women. That is, even though the estimated ideal does not constitute an overweight BMI, and even though black women are also aware of the thinner, more dominant standard, some researchers have asserted that black women reject or "disidentify" with the dominant standard and its enforcement because they associate it with a broader pattern of racial oppression (Thompson 1992). Black women have been observed to classify their own BMI according to a more forgiving criterion than the CDC standards. For example, both Dawson (1988) and Molloy

[24] See, for example, Anderson et al. (1992), Furnham and Alibhai (1983), Kemper et al. (1994), Thompson (1992), Flynn and Fitzgibbon (1998), and Lovejoy (2001), among others. While these broad racial categories are rather crude and contain within them multiple and diverse subgroups, they do appear meaningful as a rough indicator of cultural identification and shared physical preferences.

and Herzberger (1998) find that African-American women are more likely to be overweight or obese than women in other groups but less likely than other women at the same BMI to perceive themselves as such. These findings agree with our evidence of differences in body dissatisfaction reported above.

One way in which social preferences over BMI are enforced is through various forms of stigmatization such as teasing, ostracism, and employment discrimination (Myers and Rosen 1999, Puhl and Brownell 2001, Conley and Glauber 2005). A study by Latner et al. (2005) measured stigmatization of obesity relative to stigmatization of disability by asking university students to rank how well they liked various (same-sex) individuals, depicted in drawings as either obese or having a disability (such as being in a wheelchair). The most interesting results were that (1) obesity was more strongly stigmatized than most disabilities and (2) African-American women exhibited significantly less stigma against the obese peer depictions than did white women, white men, African-American men or Hispanics of either sex. Also of note was that, within any given group, obese subjects were no different in their stigmatization of the obese peer than others.

Related to the observed differences in stigmatization, black women appear to experience lower self-esteem costs associated with obesity and no significant elevation of depression risk due to obesity, whereas depression has been cited as a consequence of obesity among white women. Self-esteem and confidence have been found to influence productivity, job opportunities, and wage offers (Mobius and Rosenblat 2006, Persico et al. 2004). Therefore, black women may experience lower labor productivity costs due to obesity than white women and this may help to explain the fact that they experience lower obesity-associated wage penalties. Averett and Korenman (1999) have found that some, but not all, of the racial differences in wage penalties are in fact explained by differences in measured self-esteem between obese blacks and whites. In this example we see that even a standard economic explanation for the wage patterns, such as productivity differences, may have at its base a social explanation; at the same time we see that social preferences may have significant economic consequences.

We assert that differences in the physical ideals recognized by black and white women, and in the social punishments for deviating from the respective ideals, help to explain the persistent residual differences in BMI and obesity rates between white and African-American women. This claim agrees with the finding that differences in exercise and smoking behavior explain a significant portion of the disparities. Since the differences in these behaviors by race are not fully explained on the basis of either income or education class, they likely derive from a difference in individuals' motivations to engage in such behaviors. We cannot find justification for black women having a lower motivation to engage in exercise or take up smoking on the basis of differential health impacts of such behaviors, and yet there is evidence that social pressure to achieve a low BMI is significantly less salient for black women relative to whites of similar socioeconomic status. In addition, there is evidence that white women's impetus to exercise (and to smoke) is linked to the expected social consequences of being overweight or obese (Allan 1998). Thus we attribute the differences in exercise activity to black women's having a lower social motivation to achieve a non-overweight BMI. We expect that additional unobserved differences can be linked to differences in calorie consumption deriving from the same differences in social preferences and associated motivation.

In arguing this claim, we face two critical questions: (1) can social preference parameters be treated as exogenous to individual decisions, (2) do social preferences really influence behavior. Concerning the first, we argue that current social ideals and punishments depend on past aggregate outcomes and are therefore exogenous to any given individual in the present–and the time lag in the adjustment of social preferences to changing conditions need not be great for this to hold. (As such, pre-existing differences in ideals need not constitute the initial cause of BMI disparities; they need only exacerbate those differences.) The exogeneity claim is further supported by the finding, noted above, that obese subjects were found to be no different in their stigmatization of the obese than others; rather, stigmatization was linked to demographic group membership. Concerning the second, stigmatization of overweight and obesity, or relative lack thereof, is strongly predictive of the extent to which members of a given group exert efforts to achieve a given BMI. Observed punishments for high BMI among white women that are plausibly based on social BMI preferences, for example reductions in marriage opportunities, render a behavioral influence just as plausible as effects based on financial or health incentives. For example, a number of studies have found that black women experience significantly lower rates of bulimia and anorexia nervosa than white women, two eating disorders that have been linked to social idealization of thinness, and in general undertake less effort expressly directed at losing weight than white women of the same size (Rucker and Cash 1992, Parker et al. 1995, Powell and Khan 1995, Anderson and Hay 1985).

The observed differences in physical ideals and associated differences in outcomes can be understood in the context of a model, to be published in a forthcoming working paper by the authors, that assumes racially segregated social interactions, concern for social status, and gender-specific constraints on the ways in which social status can be produced. The model assumes that only two different physical ideals are possible: one that is close to the threshold for overweight (we set it at a BMI value of 25) and one that is close to the threshold for underweight (BMI of 19). We assume two different race groups and, within each race group, there is some proportion of wealthy individuals and some proportion of poor individuals. Individuals seek social status: women can achieve social status based on how closely they achieve the physical ideal; men can achieve social status either through achieving the physical ideal or through consumption of high-status market goods. The ideal within a given race group is determined on the basis of the historically lagged "wealthiness" of overweight: if the lagged proportion of wealthy individuals with BMI above 25 exceeds the lagged proportion of poor individuals with BMI above 25, the ideal is high. If the lagged odds of being overweight are greater among the poor, the ideal is low. Status is increasing in closeness to the ideal, but the marginal cost of deviating from the ideal depends on the average deviation in the same-race, same-sex population. Ideals are race-specific but punishments are both race and sex specific, reflecting different status valuations for men and women and the dependence of stigma on realized outcomes.

The model uses (stylized) historical values for food prices and income distributions in the United States, beginning in the early 20th century, and predicts that the ideal will initially be high for both races (and, in general, in all poor societies for which achieving a BMI of 25 is extremely costly.) However, the ideal can flip as a consequence of technology shocks that render it more expensive to achieve a

BMI of 20 than a BMI of 25. On the assumption that the wealth distribution for blacks lags behind that of whites, this flip will occur first among whites. The gender specificity of the race gap arises on account of the fact that men can produce status with either market consumption or physique. This results in a less steep (and possibly inverse) socioeconomic gradient in physique and smaller values of the multiplier effects that create the wedges between women of different race groups. Consistent with the predictions of such a model, there is some recent evidence that physical ideals may be converging across racial lines in rising generations as the socioeconomic status of blacks has improved (Striegel-Moore et al. 2000). Also consistent with this model are the seemingly contradictory facts that (1) the physical ideal for white women was previously on the plump side and has fallen significantly since the early to mid-20th century (Voracek and Fisher 2002) despite the fact that obesity has risen dramatically over the same period, and (2) the movement to reduce the stigma associated with obesity is growing as a consequence of increased social prevalence of obesity (Anesbury and Tiggemann 2000). Because the model derives physical ideals endogenously and simultaneously with realized BMI distributions, and generates testable and falsifiable predictions, we can overcome the critique that sociocultural ideals are an "easy out" in explaining differences in BMI outcomes.

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Table 1: Percent of Population Age 20-74 Obese by Gender, Race, and Poverty Status[1]

	1960-62	**1971-74**	**1976-80**	**1988-94**	**1999-02**	**2001-04**
			20-74 Years, Age adjusted[3]			
Total population:						
Both sexes	13.3	14.6	15.1	23.3	31.1	32.1
Male	10.7	12.2	12.8	20.6	28.1	30.2
Female	15.7	16.8	17.1	26.0	34.0	34.0
Not Hispanic or Latino:						
White, male	—	—	12.4	20.7	28.7	31.0
White, female	—	—	15.4	23.3	31.3	31.5
Black/African American, male	—	—	16.5	21.3	27.9	31.2
Black/African American, female	—	—	31.0	39.1	49.6	51.6
Percent of poverty level:[2]						
Below 100%	—	20.7	21.9	29.2	36.0	34.9
100%-less than 200%	—	18.4	18.7	26.6	35.4	34.6
200% or more	—	12.4	12.9	21.4	29.2	30.6
			20 Years and Over, Age adjusted[3]			
Total population:						
Both sexes	—	—	—	22.9	30.4	31.4
Male	—	—	—	20.2	27.5	29.5
Female	—	—	—	25.5	33.2	33.2
Not Hispanic or Latino:						
White, male	—	—	—	20.3	28.0	30.2
White, female	—	—	—	22.9	30.7	30.7
Black/African American, male	—	—	—	20.9	27.8	30.8
Black/African American, female	—	—	—	38.3	48.8	51.1
Percent of poverty level:[2]						
Below 100%	—	—	—	28.1	34.7	33.7
100%-less than 200%	—	—	—	26.1	34.1	33.6
200% or more	—	—	—	21.1	28.7	30.0

Notes: —Data not available. [1]Based on CDC Trend tables and Chartbook Tables in Excel format, 2006 Edition, Table 73 (http://www.cdc.gov/nchs/hus.htm). [2]Poverty level is based on family income and family size. Persons with unknown poverty level are excluded. [3]Age adjusted to the 2000 standard population using five age groups: 20-34 years, 35-44 years, 45-54 years, 55-64 years, and 65 years and over (65-74 years for estimates for 20-74 years).

Table 2: Determinants of BMI, Linear Regressions, NHANES 1999-2004, Women age 25-75

	(1)	(2)	(3)	(4)
African American	**3.681*****	**3.227*****	**3.462*****	**3.024*****
	(0.315)	(0.596)	(0.319)	(0.696)
High school	-0.339	-0.387	-0.136	-0.125
	(0.319)	(0.365)	(0.335)	(0.383)
Some college	-0.925***	-1.073***	-0.365	-0.458
	(0.306)	(0.344)	(0.332)	(0.364)
African American $*$ High school		0.028		-0.646
		(0.930)		(0.416)
African American $*$ Some college		0.956		-1.724***
		(0.693)		(0.329)
Middle income			-0.546	-0.380
			(0.399)	(1.019)
High income			-1.675***	0.609
			(0.313)	(0.779)
African American $*$ Middle income				0.611
				(0.746)
African American $*$ High income				0.287
				(0.828)
N	5650	5650	5154	5154
R^2	0.048	0.049	0.060	0.060

Notes: Standard errors are reported in parentheses. All regressions also control for age. *Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 3: Determinants of Obesity, Logistic Regressions, NHANES 1999-2004, Women age 25-75

	(1)	(2)	(3)	(4)
African American	**2.242*****	**1.773*****	**2.081*****	**1.645*****
	(0.167)	(0.263)	(0.161)	(0.263)
High school	0.926	0.882	0.989	0.961
	(0.096)	(0.105)	(0.110)	(0.122)
Some college	0.769***	0.716***	0.906	0.861
	(0.073)	(0.081)	(0.097)	(0.108)
African American * High school		1.220		0.847
		(0.268)		(0.092)
African American * Some college		1.480**		0.587***
		(0.278)		(0.047)
Middle income			0.875	1.083
			(0.087)	(0.268)
High income			0.600***	1.302
			(0.046)	(0.279)
African American $*$ Middle income				1.198
				(0.203)
African American $*$ High income				1.161
				(0.235)
N	5650	5650	5154	5154
$P - value$	0.000	0.000	0.000	0.000

Notes: Estimated effects are reported as odds-ratios. Standard errors are reported in parentheses. All regressions also control for age. *Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 4: Determinants of BMI and Obesity, NHANES 1988-1994, Age 25-75

	Linear Regression		Logistic Regression	
	Women	Men	Women	Men
Age	0.471***	0.340***	1.145***	1.176***
	(0.108)	(0.058)	(0.045)	(0.043)
Age squared	-0.004***	-0.003***	0.999***	0.998***
	(0.001)	(0.001)	(0.000)	(0.000)
(Ref. White (Non-Hispanic)				
African American (Non-Hispanic)	**1.989*****	**-0.009**	**1.507****	**1.139**
	(0.424)	(0.249)	(0.257)	(0.149)
Hispanic	2.258***	1.045**	1.440*	1.337
	(0.647)	(0.422)	(0.284)	(0.364)
Other Race or ethnicity	1.200	-0.482	1.756**	1.052
	(0.955)	(0.466)	(0.489)	(0.460)
(Ref. Less than high school)				
High School	0.490	-0.126	1.003	0.905
	(0.425)	(0.289)	(0.161)	(0.134)
Some College (or above)S	-0.783*	-0.796***	0.697*	0.665***
	(0.446)	(0.248)	(0.136)	(0.090)
(Ref. Low income)				
Middle income	-0.118	0.496*	1.017	1.063
	(0.419)	(0.295)	(0.152)	(0.185)
High income	-1.061***	0.076	0.685*	0.913
	(0.408)	(0.266)	(0.136)	(0.177)
Married	0.284	0.671***	0.947	1.276
	(0.413)	(0.237)	(0.133)	(0.219)
Foreign-born	-0.482	-0.688**	0.876	0.583*
	(0.551)	(0.347)	(0.228)	(0.170)
Height	-0.029	0.077*	0.990	1.011
	(0.063)	(0.042)	(0.023)	(0.025)
Smoker	-1.884***	-1.718***	0.655***	0.434***
	(0.428)	(0.258)	(0.100)	(0.055)
Less Active	2.785***	1.000**	2.199***	1.583***
	(0.419)	(0.420)	(0.300)	(0.272)
(Ref. Equally active, rel. to others same age)				
More Active	-1.027**	-1.118***	0.598***	0.511***
	(0.446)	(0.228)	(0.091)	(0.081)
Unemployed	0.648*	-0.183	1.310*	0.939
	(0.365)	(0.279)	(0.200)	(0.131)
Birth	0.542		1.543	
	(0.714)		(0.561)	
Birth Missing	0.072		1.482	
	(0.700)		(0.543)	
Midwest	-0.460	-0.473	0.963	0.831
	(0.817)	(0.294)	(0.230)	(0.133)
South	-0.573	-0.703***	0.869	0.761**
	(0.916)	(0.218)	(0.243)	(0.098)
West	-0.245	-0.181	1.067	1.014
	(0.820)	(0.309)	(0.269)	(0.195)
Not Metro	-0.043	0.519**	0.972	1.254*
	(0.441)	(0.214)	(0.157)	(0.168)
Constant	17.361***	14.255***		
	(4.362)	(3.079)		
N	7717	7717	7717	7717
$R^2, P-value$	0.126	0.1032	0.000	0.000

Notes: Standard errors are reported in parentheses. *Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

Table 5: Determinants of Obesity, Logistic Regressions, BRFSS 1998-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Ref. White)							
African American	**2.448*****	**2.310*****	**2.306*****	**2.333*****	**2.332*****	**2.101*****	**2.023*****
Hispanic	1.515***	1.371***	1.363***	1.395***	1.396***	1.244***	1.169***
Age	1.082***	1.089***	1.089***	1.089***	1.089***	1.106***	1.104***
Age squared	0.999***	0.999***	0.999***	0.999***	0.999***	0.999***	0.999***
(Ref. Less than High School)							
High school		0.810***	0.806***	0.809***	0.809***	0.883***	0.931***
Some college (or above)		0.530***	0.525***	0.530***	0.531***	0.664***	0.702***
(Ref. Year 1998)							
Year 1999			1.053**	1.053**	1.055**	1.062***	1.129***
Year 2000			1.121***	1.121***	1.125***	1.150***	1.152***
Year 2001			1.231***	1.230***	1.238***	1.275***	1.289***
Year 2002			1.226***	1.225***	1.232***	1.277***	1.296***
Food CPI (by MSA-year)					0.999***	0.999**	0.999**
(Ref. Income Category 1)							
Income Category 2						1.164***	1.147***
Income Category 3						1.095***	1.106***
Income Category 4						0.982	1.023
Income Category 5						0.908***	0.952*
Income Category 6						0.839***	0.899***
Income Category 7						0.700***	0.762***
Income Category 8						0.480***	0.526***
Exercise							0.625***

Notes: Estimated effects are reported as odds-ratios. All regressions also control for age. *Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

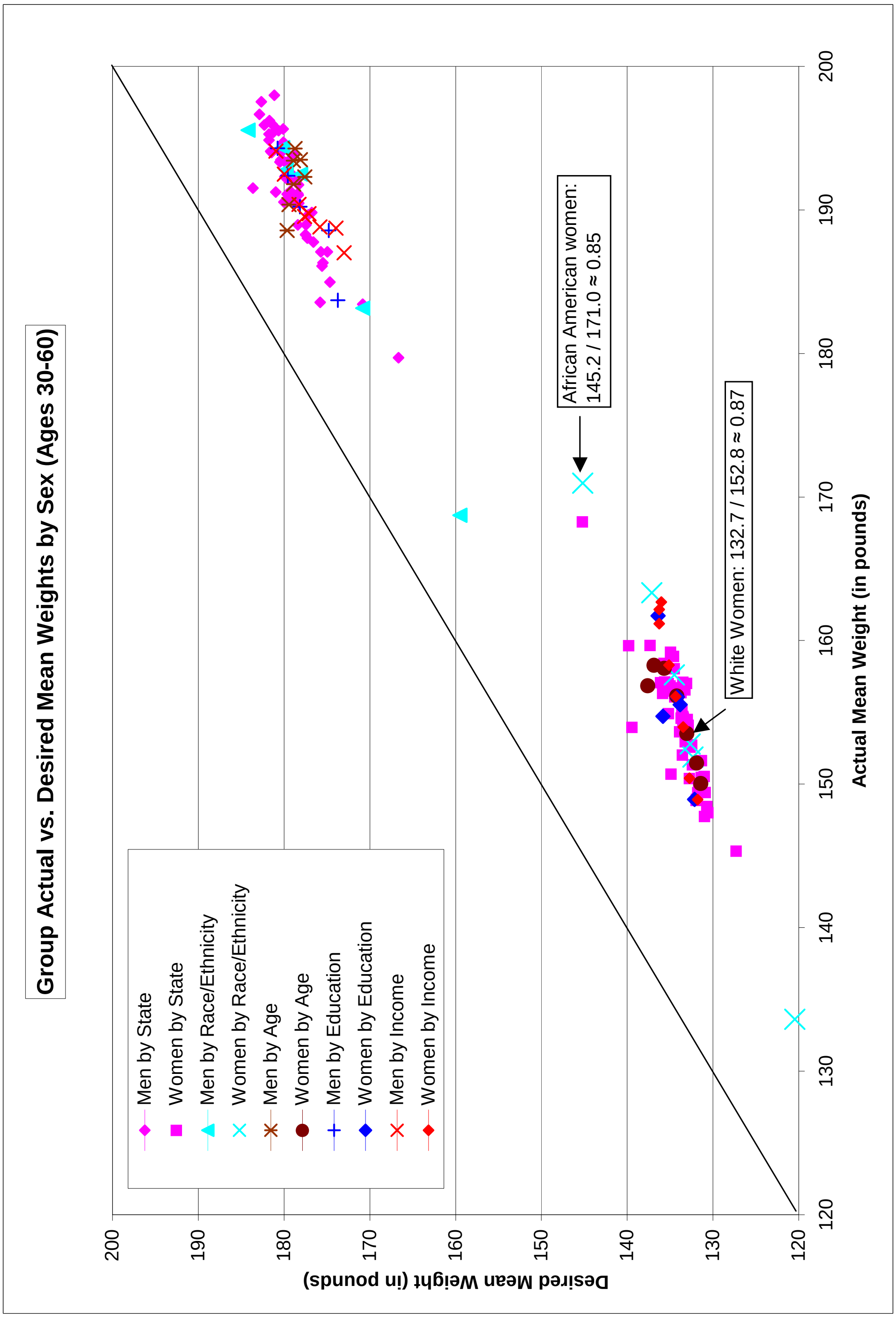

Figure 1: Relationship between Desired and Actual Weight by Groups (Source: BRFSS various years)

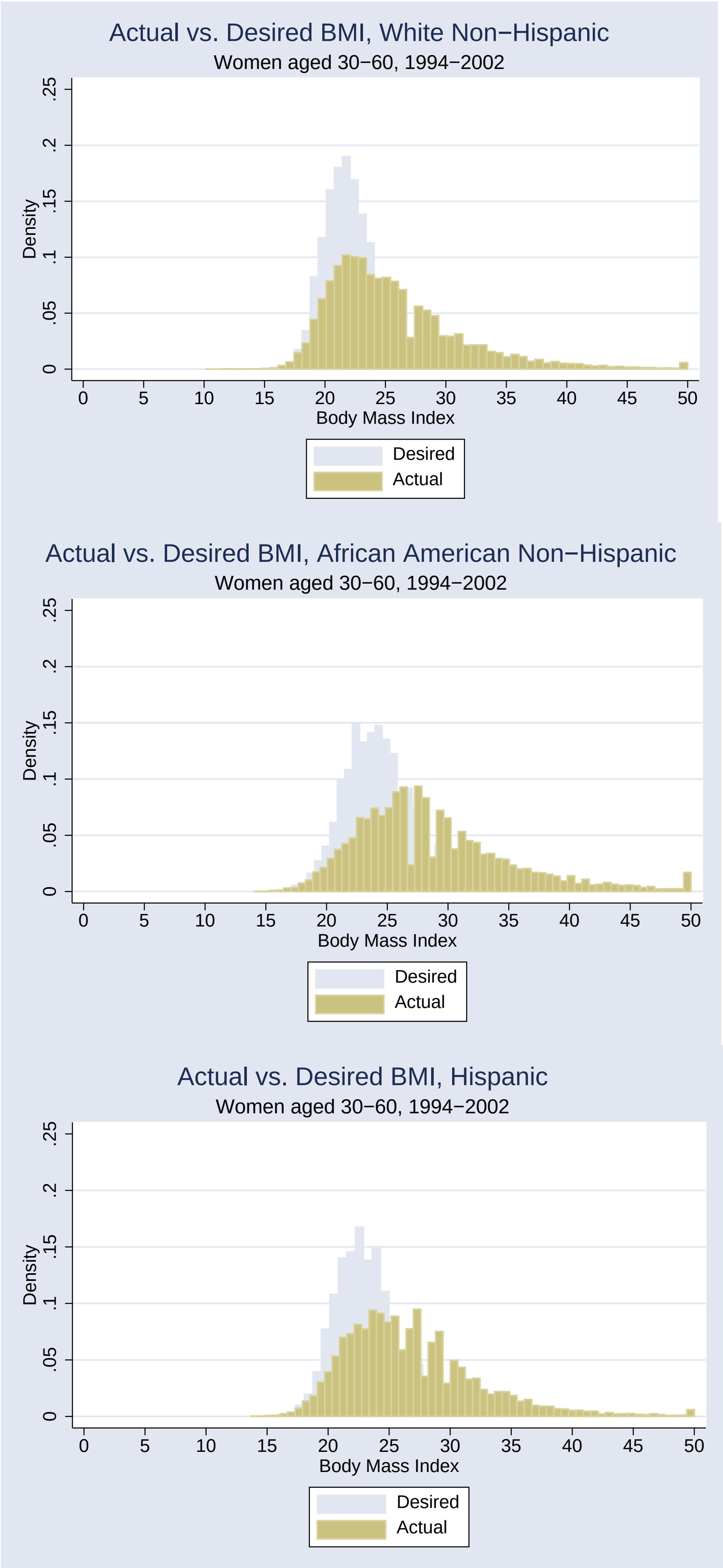

Figure 2: Female Actual and Desired Body Mass Index - White, African American Non-Hispanic, and Hispanic 1994-2002 (Source: Computed from BRFSS various years)

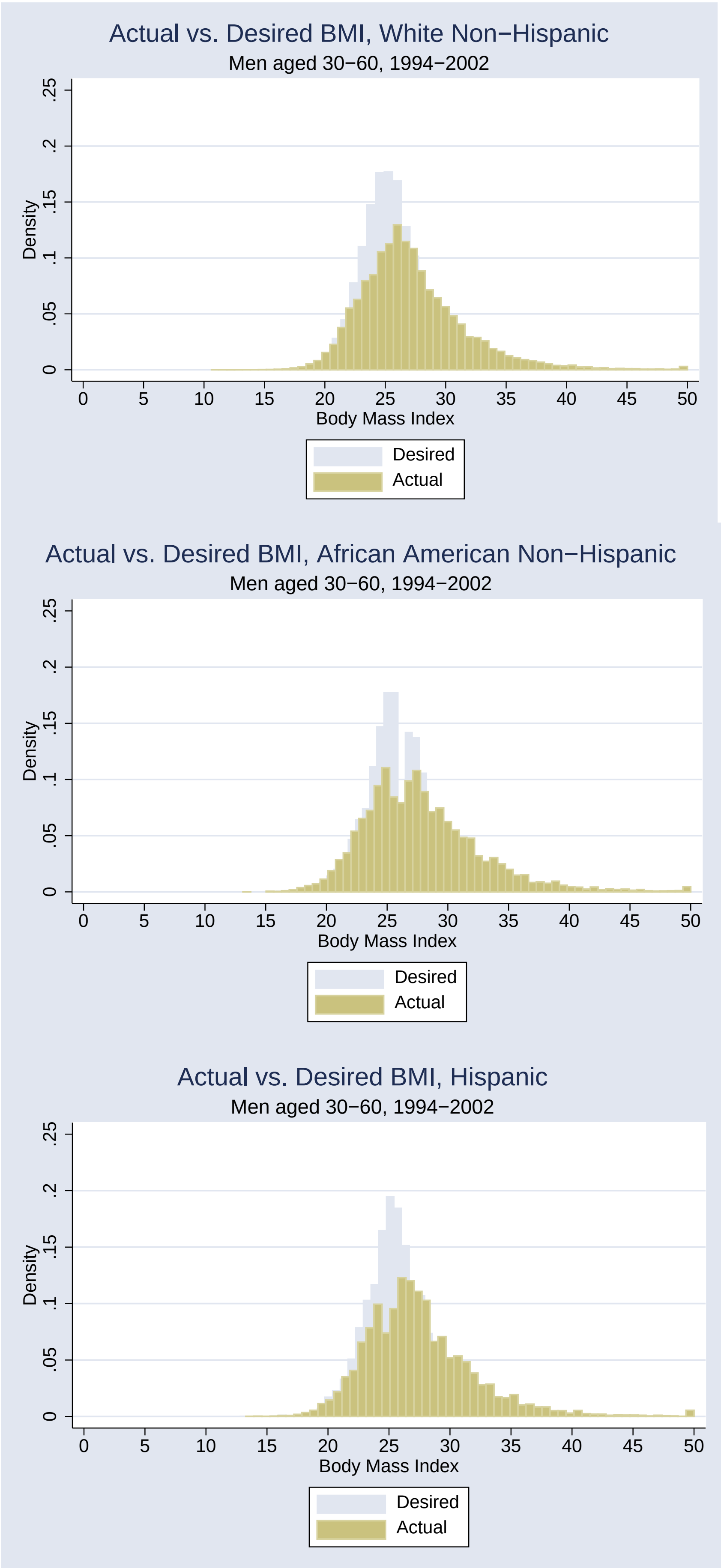

Figure 3: Male Actual and Desired Body Mass Index - White, African American Non-Hispanic, and Hispanic 1994-2002 (Source: Computed from BRFSS various years)