SEGREGATION AND OBESITY PREVALENCE AMONG U.S. ADULTS

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ABSTRACT

Using data from the 1990-1994 National Health Interview Survey, this paper examines race differentials in obesity as both individual and neighborhood-level phenomena. We find that neighborhoods characterized by high proportions of black residents are four times more likely than areas in which the majority of the residents are white to exhibit a high prevalence of obesity. Using individual-level data we also find that residents of neighborhoods in which at least one-quarter of the residents are black face a thirteen percent increase in the relative odds of being obese compared to residents of other communities. Roughly fifteen percent of the elevated risk of obesity among black adults is due to differential racial concentration across neighborhoods but the association between neighborhood racial composition and obesity is completely attenuated after including statistical controls for the poverty rate and obesity prevalence of respondent's neighborhoods. These findings support key tenets of both the institutional and epidemic models of neighborhood effects.

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INTRODUCTION

The causes of obesity, including the social relationships that mediate and moderate the relationship between obesity and known risks, are complex (Weinsier et al. 1998; Whitaker 2002; Bloomgarden 2002). As research consistently demonstrates that behaviors affecting health are rooted within individuals' social environments (Berkman and Kawachi 2000) it is critical to broaden the scope of inquiry such that health is understood not only as a function of individual traits, but also as characteristics of the environments in which people live (Macintyre and Ellaway 2003; Robert 1999). These environments include physical space as well as community attitudes and behaviors that characterize these places (Frolich, Corin, and Potvin 2001). Although literature linking residential context to health has increased sharply in recent years (see Kawachi and Berkman 2003 for an overview), little work has examined obesity as an outcome. This article contributes to the growing body of work focusing on the ecological correlates of health and makes a timely contribution to the recent focus on obesity in both academic and popular settings.

It is important to fully understand obesity because obesity prevalence among U.S. adults has increased to epidemic levels, has contributed to an increased risk of disease, disability, and death, and has led to an escalation in health care costs (Allison, Zannolli, and Narayan 1999b; Wang et al. 2002). Over the last twenty-five years, the prevalence of adult obesity has more than doubled (Pastor et al. 2002). In 1976 only 15 percent of the adult population was obese, but by 2000 adult obesity rates surpassed 30 percent (NCHS 2003). This increase is particularly problematic because obesity is associated with an

increased risk of serious health problems including type-2 diabetes, gallbladder disease, high blood pressure, and heart disease (Denney et al. 2004; Flegal et al. 2002; Calle et al. 2003; Kaplan 2000; Must et al. 1999). More importantly, obesity increases the risk of a number of causes of death and is believed to contribute to approximately 14 percent of all deaths per year in the U.S. (Allison et al. 1999; McGinnis and Foege 1993; Rogers, Hummer, and Krueger 2003; Sturm 2002).

Of particular concern to social epidemiologists is consistent evidence demonstrating a substantially higher rate of obesity among non-Hispanic blacks compared to non-Hispanic whites in the U.S. (Flegal et al. 2002; Durazo-Arvizu et al. 1998; Mokdad et al. 2003; Schoenborn, Adams, and Barnes 2002). In large part, studies examining the elevated risk of obesity among black adults focus almost exclusively on individual level resources; however, it is clear from previous research that racial differences in body mass persist despite statistical controls for known risk factors at the individual-level (Lakdawalla and Philipson 2002; Sundquist and Johansson 1998). Accordingly, researchers have begun to focus their attention on various aspects of adult's neighborhoods. The renewed interest in work establishing linkages between context, collective action, and negative health behaviors (Macintyre et al. 2002) is due in large part to consistent findings across a number of studies showing that various aspects of neighborhoods are independently associated with the health (Robert 1999; and Yen and Syme 1999) and health-related behaviors (Boardman et al. 2001; Ross 2000; Duncan, Jones, and Moon 1996).

In this paper, we examine several aspects of individual's residential areas as potential determinants of their physical size. We first describe the social ecology of

obesity by examining racial and socioeconomic correlates of obesity prevalence across residential areas. We then estimate the independent association of three residential characteristics (race, class, and health) on the risk that an individual will be obese. We pay particular attention to possibility that neighborhood-level racial composition, poverty rates, and obesity prevalence are positively associated with risk of obesity among adults. These models provide an empirical examination of the epidemic model, institutional model, and collective socialization model of neighborhood-health relationships (Jencks and Mayer 1990).

HEALTH, PLACE, AND RACE

The relationship between residential context and well-being is broadly understood in reference to the neighborhood effects paradigm (Jencks and Mayer 1990). Research in this area addresses a relatively straightforward question: are neighborhood characteristics associated with people's broadly defined life chances regardless of their personal characteristics (Robert 1998)? Although recent work has elaborated the relationship between neighborhood context and adult's health (see Frolich et al. 2001 for a useful discussion), three models of neighborhood effects presented by Jencks and Mayer (1990) remain the most widely cited and popularly understood mechanisms through which the social, cultural, and economic characteristics of individual's neighborhoods affect their well-being. The *institutional model* claims that residents of relatively disadvantaged communities will present more deleterious health profiles compared to residents of more affluent communities – regardless of their personal characteristics – because important health promoting infrastructure (Morland, Wing, and Diez-Roux 2002; Lee and Cubbin

2002; Saelens et al. 2003) and health-related services (Perloff and Jaffee 1999; Kotranski, Bollick, and Halbert 1987; O'Loughlin et al. 1999) are inaccessible, ineffective, or at times unavailable in impoverished communities. For example, researchers draw on institutional explanations for the increased risk of alcohol use and abuse in predominantly black communities when they highlight the disproportionate concentration of alcohol outlets in these areas (Scribner et al. 1999). Similarly, the institutional model of neighborhood effects may highlight the concentration of polluting industries or congested major transportation networks within disadvantaged communities (Downey 2003) as a potential explanation for elevated risk of poor health in these areas.

Whereas the institutional model focuses on risks and resources that are external to the residents, the *epidemic* and *collective socialization models* focus on norms, values, and beliefs that are unique to the residents of the neighborhoods. These models are similar in that each hypothesizes neighborhoods as providing a social context in which otherwise subcultural values regarding health-related behaviors become normative (Jencks and Mayer 1990). Neighborhood context can influence behavior directly via imitation processes, or indirectly through the internalization of norms and attitudes present within the collective lifestyles of the neighborhood. For example, the concentration of individuals within a neighborhood with elevated weight may lead to an overarching acceptance of obesity as collective attitudes toward obesity discredit or dismiss (directly or indirectly) the potential harms of being obese. These social interactions occurring within neighborhoods may ultimately place all residents of the community at an elevated risk of being obese.

The epidemic and collective socialization models differ one from another with respect to the functional form that each is believed to take. The epidemic model suggests that the risk of obesity among a randomly selected individual from a neighborhood increases exponentially with the prevalence of obesity within the area; the estimated net effect of neighborhood obesity rates on the risk of individuals being obese increases with increasing obesity prevalence within neighborhoods. Crane (1991) summarizes the epidemic model as follows: "if the incidence stays below a critical point, the frequency or prevalence of the problem tends to gravitate toward some relatively low-level equilibrium. But if the incidence reaches a critical point, the process of spread will explode" (1227). Borrowing from traditional models of disease progression in populations, the epidemic model is unique because the risk associated with contextual characteristics is believed to increase without bounds beyond some "tipping point" (see for example Granovetter 1978).

The collective socialization model also predicts a nonlinear specification in the relationship between neighborhood context and the risk of social problems, but differs from the epidemic model because it predicts a stabilization in the risk of some deleterious outcome beyond the hypothesized "tipping point." The collective socialization model differs in that the normative environment is believed to be discrete; changes in the obesity composition of the neighborhoods denote qualitative rather than quantitative shifts in the meaning of health problems. According to the epidemic model, the relationship between the obesity rate of a neighborhood and the risk of obesity among a resident of the community is best characterized as quadratic in nature. However, the collective

socialization model predicts that this same relationship may be more accurately described as a cubic function.

The neighborhood epidemic and collective socialization models are important for understanding race differences in obesity because black adults may prefer larger body sizes (Flynn and Fitzgibbon 1998; Hebl and Heatherton 1998), which may in turn affect motivations to lose weight (Kumanyika 1993). These preferences may also translate into different sanctions when aggregated to more abstract social levels; the increased acceptance of elevated weight among non-Hispanic blacks decreases the costs associated with obesity, subsequently increasing the likelihood that black individuals will be obese (Dawson 1988). For example, a study of undergraduate female college students revealed that compared to whites, African American females reported higher current body masses, higher desired body masses, and higher body masses perceived to be desired by others (DiGioacchino, Sargent, and Topping 2001). Further, Stevens, Kumanyika, and Keil (1994) found that compared to obese white women, obese black women were more than twice as likely to be satisfied with their weight.

To date, little work has investigated the ways in which adult's immediate residential context factors into their perceptions of normal weight and their subsequent likelihood of engaging in health-promoting activities to maintain or attain a particular physical weight. More importantly, given the observed differences among black and white adults with respect to the risk of obesity as well as perceived body size, it is possible that the heightened prevalence of obesity within black communities is independently associated with the risk of obesity among the residents of the immediate area. This is an important aspect of the notion of residential concentration that has been

overlooked. That is, the concentration of racial and ethnic minorities is deemed largely problematic because of group-level differences in socioeconomic well-being (Jargowsky 1997). Specifically, because black Americans are three times more likely than whites to have family incomes below the official poverty line (Proctor and Dalaker 2002), the concentration of non-Hispanic blacks within particular neighborhoods also concentrates poverty and a host of social problems associated with poverty. Here, we consider the possibility that residential racial concentration leads to elevated rates of obesity among black compared to white adults because of race differences in the prevalence of obesity (epidemic model or collective socialization model) and race differences in neighborhood socioeconomic status (institutional model).

HYPOTHESES

Based on the literature reviewed above, we test three hypotheses:

Hypothesis 1: Residents of black communities face an increased risk of obesity compared to residents of non-black communities and the elevated risk of obesity among black adults is due in part to residential racial concentration.

Hypothesis 2: Neighborhood poverty rates are positively associated with the risk of obesity among adults and the elevated risk of obesity in predominantly black communities is due to disparate levels of socioeconomic resources across black and white communities (institutional model).

Hypothesis 3: Individuals residing in relatively obese communities will face an increased risk of being obese themselves and the elevated risk of obesity in predominantly black communities is due to neighborhood differences in obesity rates. The

relationship between neighborhood obesity rates may increase rapidly and continue to increase (epidemic model) or increase rapidly but then plateau (collective socialization model).

METHODS

Data

Individual- and neighborhood-level data come from the 1990 to 1994 National Health Interview Survey (NHIS; NCHS various years). NHIS is an annual, nationally representative survey of non-institutionalized individuals used to examine national trends in illness and disability and to track progress toward achieving national health objectives (Schoenborn, Adams, and Schiller 2003). Individual level information from the NHIS includes height, weight, age, sex, race, educational attainment, and whether the individual lives below the poverty level. Data were limited to 1994 due to the reconstructed sampling design that occurred in 1995.

Neighborhood-level data are derived from a methodology developed by Wells and Horm (1998) of the National Center for Health Statistics (NCHS). To protect respondents, NCHS excludes small geographic identifiers from public release data sets. Because the NHIS sampling frame is based on census blocks and block groups, Wells and Horm use the term "very small areas" (VSA) to denote the geographic areas referred to as neighborhoods in the present analyses. VSAs provide three unique advantages in contextual analyses. First, because VSAs are smaller than census tracts, they may provide a more accurate indicator of neighborhoods (Bond Huie 2001; Brooks-Gunn, Duncan, and Aber 1997; Booth and Crouter 2001). Second, the NHIS is available on an annual

basis and the geographic identifiers for the VSAs do not vary, which provides neighborhood data for each year of the NHIS (Massey et al. 1989). Last, these areas are defined so that they capture similar social, economic, and cultural characteristics of the area.

NHIS collected information from 402,154 respondents over the five-year period. Because VSA-level information is derived from the aggregation of individual respondents and multiple records per household were collected in the NHIS, the prevalence of obesity in a neighborhood may be exaggerated or decreased because of differences in the number of respondents per household. Accordingly, we randomly selected one adult per household for these analyses. This process provided a reduced sample of 220,347 respondents. Of these adult respondents, we dropped 2.9 percent or 6,302 adults from the analyses because small VSA-level sample sizes (i.e., less than 10 respondents per VSA) may lead to unreliable neighborhood-level measures (Raudenbush and Sampson 1999). This produced a final data set of 220,347 respondents from 7,953 neighborhoods. Overall there was an average of 29.6 respondents per neighborhood (s.d. = 9.8), with a minimum of 10 and a maximum of 76.

Measures

The dependent variable, obesity, is a binary measure, coded 1 if an individual is obese and 0 if not obese. Obesity is determined if an individual's body mass index (BMI) is greater than or equal to 30. BMI is calculated by dividing an individual's weight (in kilograms) by his or her height in meters squared (World Health Organization 1997).

Previous research finds that self-reported data such as these to be reliable measures of physical size (Stewart 1982).

Because of our interest in black-white differences in the risk of obesity, only respondents who described themselves as non-Hispanic white (reference group) or non-Hispanic black were included.[1] Additional individual-level measures include sociodemographic and socioeconomic variables that are associated with both race and obesity (Flegal et al. 2002; Durazo-Arvizu et al. 1998). First, given the non-linear relationship between age and obesity (Himes 2000; Krueger et al. 2004), we use four age categories in all analyses: 18-29, 30-49, 50-69, and 70 and beyond. Sex is coded 1 for males and 0 for females. Educational attainment includes less than high school, high school graduate, and greater than a high school education (the referent). Finally, poverty is a dichotomous measure, coded 1 for individuals who are living at or below the poverty threshold. The poverty threshold is based on family size, number of children under 18 years of age, and family income, using poverty levels from the particular NHIS survey year derived from the subsequent year's Current Population Survey.

Neighborhood-level independent variables are calculated by aggregating individual's responses within each respective VSA. Three characteristics of respondent's neighborhoods are assessed: the proportion of residents who are non-Hispanic black, the proportion of residents who are poor, and the proportion of residents who are obese.[2] Non-Hispanic black and poor communities are identified as areas in which at least 25 percent of the residents are black or poor, respectively. Because we are interested in the functional form of the relationship between neighborhood obesity and the risk of individual residents being obese (epidemic or collective socialization), we use the

following six levels of neighborhood obesity: (1) 0-5 percent, (2) 5-10 percent, (3) 10-15 percent, (4) 15-20 percent, (5) 20-25 percent, and (6) more than 25 percent.

Statistical Analyses

Due to the multilevel character of the research questions, we use the SAS GLIMMIX macro to estimate multilevel generalized linear models with a logit link and a binary distribution. Error across neighborhoods is captured with a level-2 residual term that is believed to be normally distributed with a mean of 0 and an unknown variance of σ_u^2 (Littell et al. 1996; McCulloch and Searle 2001). The multilevel model for binary outcomes is conceptually quite similar to a traditional logistic regression model with the inclusion of the neighborhood-level error component (u_j). The following equation represents a multilevel equation for the probability of being obese, allowing obesity to vary across neighborhoods and including individual-level (x_{ij}) and neighborhood-level (z_j) explanatory variables:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_0 + \beta_1 x_{ij} + \beta_2 z_j + u_j \qquad (1)$$

The probability (p_{ij}) that the i^{th} individual in the j^{th} neighborhood is obese is captured in equation 1. The variance of the level-2 residual (σ_u^2) can be used to estimate the extent to which variation in the log-odds of obesity is situated within or between neighborhoods. The intra-class correlation coefficient is simply the ratio of level-2 residual variance to the overall residual variance ($\sigma_u^2 + \sigma_e^2$). Snijders and Bosker (1999) and Guo and Zhao (2000) suggest using $\Pi^2/3$ (the variance of the standard logistic

distribution) as an estimate for the level-1 residual variance when modeling binary outcomes in a multilevel framework. Finally, because NHIS uses a clustered, stratified, unequal probability sampling frame, we weighted all estimates to reflect the civilian, noninstitutionalized adult population (Massey et al. 1989).

RESULTS

Table 1 presents obesity prevalence rates across neighborhoods in the years 1990 through 1994. The average neighborhood in the United States had an obesity rate of 14.7 percent during these years and nearly 15 percent of adults in the U.S. resided in communities where at least one-quarter of the residents were obese. The overall black and non-black community prevalence rates are strikingly different. In particular, less than 10 percent of non-black areas had obesity rates that exceeded 25 percent, but nearly two out of every five (37.6 percent) black communities presented similarly high obesity levels. Whereas 14.3 percent of non-black areas had very low obesity rates, only 3.4 percent of black communities had obesity prevalence rates below 5 percent.

[TABLE 1 ABOUT HERE]

A similar pattern emerges when comparing poor and non-poor areas: poor areas were three times more likely than non-poor areas to have obesity rates that exceeded 25 percent. Given that black communities are overrepresented among relatively impoverished areas (Jargowksy 1997), we also consider the relationship between racial composition and obesity prevalence rates across poor and non-poor areas. Whereas more

than 50 percent of impoverished black communities had obesity prevalence rates beyond 25 percent only 22 percent of non-black communities had obesity rates this high. The prevalence of high obesity among black communities was the lowest in non-poor areas; however, obesity rates in non-poor black communities were still higher than obesity rates in poor non-black communities. In addition, the relative risk of high obesity rates across black and non-black communities indicates that socioeconomic differentials are only partly responsible for these differences. To illustrate, black communities are 3.8 times as likely as white communities to have obesity rates beyond 25 percent but this relative risk drops to 3.4 when comparing black and white communities in non-poor areas and even further (2.3) when comparing black and white communities in poor areas.

[TABLE 2 ABOUT HERE]

To more fully appreciate these relationships, we merged neighborhood-level data with individual-level records from NHIS. Table 2 presents descriptive statistics for black and white respondents. Of particular interest in this table are the observed race differentials in obesity when measured at the individual and the neighborhood-level. Specifically, the relationship between race, obesity, and residential context becomes clearer when one considers that black respondents are 1.7 times as likely as whites to be obese, but they are 3.1 times as likely to reside in relatively obese communities. What remains unclear is the extent to which individual and neighborhood-level differences between blacks and whites account for the elevated rates of obesity within black communities and the increased risk of obesity among individual black adults. To

investigate these relationships further, Table 3 presents estimates from a series of multilevel logistic regression models in which odds-ratios are estimated for each risk factor. These estimates are derived from individual-level data nested within neighborhoods where the dependent variable is coded 1 if respondents are obese and 0 if otherwise.

Model 1 presents a baseline estimate for neighborhood-level variation in the risk of obesity among adults. According to this estimate, 8 percent of the variation in the risk of obesity is due to the unobserved characteristics associated with respondent's neighborhoods. Model 2 presents the baseline risk of obesity among black adults. As with the estimates presented in Table 2, the parameter estimate in Model 2 suggests that black adults face an 88 percent increase in the relative odds of being obese compared to whites (p_b=.228; p_w=.136; o_b=.295; o_w=.157; o_b/o_w=1.88). Model 3 examines the extent to which the elevated risk of obesity among black adults is due to sociodemographic differences between blacks and whites. According to these estimates, 13 percent of the elevated risk of obesity among black compared to white adults is due to sociodemographic differences in the two groups.[3]

[TABLE 3 ABOUT HERE]

Model 4 controls for the racial composition of respondent's neighborhoods and provides a test of Hypotheses 1. As hypothesized, residing in a black community is positively and significantly associated with an increased risk in obesity among adults. Those residing in communities in which at least one-quarter of the residents are black

face a 13 percent increase in the odds of being obese compared to residents of communities with smaller proportions of blacks. Equally important, as expected, differences among black and white respondents in the racial composition of their neighborhoods attenuated the estimated net effect of race by roughly 15 percent. In other words, black adults face an increased risk of obesity compared to whites because they are more likely to reside in neighborhoods with high concentrations of black residents.

Models 5 and 6 are designed to account for the elevated risk of obesity among residents of black communities (Hypothesis 2). By controlling for socioeconomic characteristics and obesity profiles of respondents' neighborhoods, the goal is to reduce the net effect associated with residing in a black community to zero. Model 5 controls for the prevalence of poverty in respondents' neighborhoods. Residence in a relatively impoverished community is positively associated with an increased risk of obesity. Further, in support of the institutional framework of neighborhood dynamics, socioeconomic differences among white and non-white areas neighborhoods explains nearly 30 percent of the effect associated with neighborhood racial composition. In other words, residents of black communities face an increased risk of obesity because important health-promoting infrastructural resources may be absent in these relatively disadvantaged communities.

Model 6 tests the epidemic and collective socialization models (Hypothesis 3) by including statistical controls for the prevalence of obesity in respondent's neighborhoods. We are interested in three aspects of this relationship: (1) the direction and significance, (2) the functional form, and (3) the extent to which these controls attenuate the residual effect of the neighborhood racial composition variable from Model 5. First, each level of

neighborhood obesity rate is strongly associated with the subsequent risk of obesity for individual residents. Keeping in mind that the prevalence of obesity excludes the respondent, these findings suggest that individuals are more likely to be obese if they reside in a community in which a relatively high proportion of the residents are obese. Second, the observed increase in the relative odds of being obese as respondents move from neighborhoods with average obesity levels (OR= 1.34) to above average levels (OR = 1.62) is consistent with both the epidemic and collective socialization models. According to the collective socialization model, this increase should subside rapidly with increasing levels of obesity. Instead, we continue to see increases in the relative odds of individuals being obese when they reside in communities where 20-25 percent (OR=1.68) and more than 25 percent (OR =1.77) of their neighbors are obese. These estimates suggest that the phenomenon of obesity as related to neighborhood processes is best characterized as epidemic in nature. Third, and most importantly, statistical control for the prevalence of obesity in respondent's neighborhoods reduces the effect of the racial composition of respondent's neighborhoods to zero. In other words, the elevated risk of obesity among residents of black communities is due in part to institutional characteristics of these neighborhoods, but also because obesity levels within these levels cross important epidemic thresholds.

DISCUSSION

A thorough examination of the factors that contribute to adult obesity provides valuable information concerning the rising levels of obesity in the United States. The results presented above effectively demonstrate that contextual predictors at the

neighborhood level provide valuable insight into the risk of obesity among adults. Indeed, individuals living in neighborhoods characterized by relatively high proportions of obese residents are significantly more likely to be obese themselves, net of individual-level differences. These findings contribute to literature involving neighborhood-effects on health (Robert 1999) as well as social epidemiological inquiries into race differences in health and well-being (Williams and Collins 1995; Williams 1997). Blacks and whites inhabit qualitatively dissimilar areas in the United States and high levels of racial concentration leads to disparate cultural and structural environments for blacks and whites (Alba and Logan 1993; Farley and Frey 1994; Frey and Farley 1996; Massey and Denton 1993). These differences have a profound impacts on the physical well-being of black and white adults throughout the lifecourse (LaVeist 1996; Williams 1996, 1997). As shown here, the geographic and social positions of whites and blacks affect their obesity levels.

The findings suggest that increased risk of obesity among residents of black communities is due in part to socioeconomic differences in the communities, but more importantly, this risk is attenuated when the obesity rate of the neighborhood is considered. These findings support the institutional and epidemic models of neighborhood effects and suggest that elevated risk of obesity among black adults is due in part to residential racial concentration. These results confirm studies that indicate that residential racial concentration operates as an indirect effect on health outcomes, primarily through concentrated poverty (Williams 1996; Acevedo-Garcia 2000). Living in neighborhoods characterized by high levels of poverty increases the probability of a host of negative health outcomes, including increasing an individual's probability of

being obese net of individual characteristics, such as income, education, and employment status. These high poverty places are unlikely to possess structural resources essential to healthy living, such as health care facilities, nutritional outlets, and recreational facilities (Macintyre, Maciver and Sooman 1993; Wyke et al. 1992; Sooman, Macintyre, and Anderson 1993). Indeed, in poor areas, population density per food market is greater, the cost of food is higher, and the quality of available food is lower (Troutt 1993).

Epidemic models focus on how individuals within a given context influence one another's behaviors and norms. The processes result from imitation behavior and are conditioned by a willingness or susceptibility to submit to the prevailing norms present within a given locale. Our results provide support for contagion arguments that suggest that adults residing in areas characterized by high levels of obesity may minimize the costs associated with being obese. The epidemic model is not necessarily short-term and hurried, but rather a developing and progressive process. Health outcomes, and more specifically obesity, are not the result of immediate imitation processes, resulting in immediate pandemic proportions. Whereas negative behaviors such as drug activity or teenage sexual behavior might potentially be viewed as a short-term trend or epidemic (Crane 1991), obesity is a result of long-term health behaviors, including physical activities and nutritional intake that are invariably connected to institutions, as illustrated in the results. Health behaviors are not necessarily deep-rooted personality traits but rather reflect the social milieu in which one interacts (Frolich et al. 2001).

Negative health behaviors are slowly disseminated through the social and cultural environment. Individuals are not unexpectedly inflicted by unhealthy behavior, but are continually exposed over time until more and more individuals are exposed. Attitudes are

internalized and externalized and continue to influence the residents of a given area at a rapid rate. Rather than being a passive recipient or determinately susceptible to disease, the individual is influenced by his or her neighborhood over time, and concomitantly influences the neighborhood (Tienda 1991). All residents have agency and are not necessarily predetermined to become obese, but are at increased risk with increased exposure levels. Thus, the minimization of body mass concerns result from increased exposure to individuals exhibiting unhealthy practices, buttressed by institutional-level factors, including but not limited to racial concentration.

Additional measures that are not addressed in this study may also affect obesity at the neighborhood-level. The prevalence of high levels of disorder and fear in poor neighborhoods may affect neighborhood health behaviors (Ross and Mirowsky 2001), including obesity. Environments influence physical activity, and certain environments may discourage walking and exercise, and make travel dangerous (Humpel, Owen, and Leslie 2002). More advantaged areas are likely to encourage safer walking areas and promote healthy activities. Additionally, it is plausible that residents in economically disadvantaged areas are unaware of important health care information, and do not rely on their neighborhoods for health promoting activities such as exercising, and socializing (Macintyre and Ellaway 1998). Without these resources, individuals who reside in these areas may find it difficult to both realize and to implement what comprises a healthy lifestyle.

The collective minimization of obesity affects all individuals living in areas characterized by obesity, but has particularly damaging effects on blacks because of persistently highly levels of residential segregation. This suggests the importance of

policies that address specific geographic areas and specific groups. Blacks and individuals with lower SES are less likely to accept norms that encourage weight loss or that stigmatize obesity (Jeffery and French 1996; Allan, Mayo, and Michel 1993). Thus, predominately obese and black neighborhoods may be characterized by less confining attitudes toward obesity. Such relaxed attitudes may protect against market discrimination especially against obese black women but these attitudes may be unable to prevent increased risks of poor health, functional limitations, and, ultimately, death (Averett and Korenman 1996).

Social location is a vital component in the examination of adult obesity. Individuals living in disadvantaged neighborhoods characterized by higher rates of obesity are at a greater risk of obesity. Our findings suggest that obesity research is complex and multifaceted, and that studies that do not incorporate context miss an important component. Adult obesity levels in the U.S. are affected through both institutional and epidemic pathways, in which socioeconomic disadvantage and obesity at the neighborhood level affect individual-level obesity. Thus, context must be considered in conjunction with individual risk factors to more fully understand obesity – a major contributor to ill health and shortened life among U.S. adults.

ENDNOTES

1. For brevity, throughout the rest of the paper, we refer to non-Hispanic blacks and non-Hispanic whites as blacks and whites, respectively. Although it would be informative to examine other ethnic groups, their small sample sizes, especially at the neighborhood level, would lead to analytic problems, especially with the multilevel analyses.

2. Because we are interested in modeling the probability that an individual is obese given the prevalence of obesity rate in their neighborhood, the inclusion of information about that individual in the neighborhood prevalence rate would bias the parameter estimates upward and artificially lower the standard error estimates. Accordingly, each respondent receives a unique value for the obesity prevalence value as they are removed from the calculation of the neighborhood-level estimate. This same method was used to calculate neighborhood racial and socioeconomic composition.

3. Percent change in the variable NH Black is calculated with the unexponentiated parameter estimates. For example, the 13 percent change in the effect of race was determined accordingly: $\frac{\ln(1.879) - \ln(1.729)}{\ln(1.879)} = \frac{.631 - .547}{.631} = .132$

REFERENCES

Acevedo-Garcia, Dolores. 2000. "Residential Segregation and the Epidemiology of Infectious Diseases." *Social Science & Medicine* 51:1143-61.

Alba, Richard D. and John R. Logan. 1993. "Minority Proximity to Whites in Suburbs: An Individual-Level Analysis of segregation." *American Journal of Sociology* 98: 1388-1427.

Allan, Janet D., K. Mayo and Y. Michel. 1993. "Body Size Values of White and Black Women." *Research in Nursing and Health* 16: 323-33.

Allison, David B., Kevin R. Fontaine, JoAnn E. Manson, June Stevens, and Theodore B. VanItallie. 1999a."Annual Deaths Attributable to Obesity in the United States." *Journal of the American Medical Association* 282:1530-38.

Allison, David B., Raffaella Zannolli, and K.M. Venkat Narayan. 1999b. "The Direct Health Care Costs of Obesity in the United States." *American Journal of Public Health* 89: 1194-99.

Averett, Susan, and Sanders Korenman. 1996. "The Economic Reality of the Beauty Myth." *Journal of Human Resources* XXXI: 304-30.

Berkman, Lisa F., and Ichiro Kawachi. 2000. *Social Epidemiology*. Oxford: Oxford University Press.

Bloomgarden, Zachary. 2002. "New Insights in Obesity." *Diabetes Care* 25: 789-95.

Boardman, Jason D., Brian K. Finch, Christopher G. Ellison, David R. Williams, and James S. Jackson. 2001. "Neighborhood Disadvantage, Stress, and Drug Use Among Adults." *Journal of Health and Social Behavior* 42: 151-65.

Bond Huie, Stephanie A. 2001. "The Concept of Neighborhood in Health and Mortality Research." *Sociological Spectrum* 21: 341-58.

Bond Huie, Stephanie A., Robert A. Hummer, and Richard G. Rogers. 2002. "Individual and Contextual Risks of Death Among Race and Ethnic Groups in the United States." *Journal of Health and Social Behavior* 43: 359-81.

Booth, Alan and Ann C. Crouter. 2001. *Does It Take a Village? Community Effects on Children, Adolescents, and Families*. Mahwah, NJ: Erlbaum Associates, Publishers.

Brooks-Gunn, Jeanne, Greg Duncan, and J.L. Aber. 1997. *Neighborhood Poverty: Policy Implications in Studying Neighborhoods*. Vol. 2. New York: Sage Foundation.

Calle, Eugenia E., Carmen Rodriguez, Kimberly Walker-Thurmond, and Michael J. Thun. 2003. "Overweight, Obesity, and Mortality from Cancer in a Prospectively Studied Cohort of US Adults." *New England Journal of Medicine* 348: 1625- 38.

Crane, Jonathan 1991. "The Epidemic Theory of Ghettos and Neighborhood Effects on Dropping Out and Teenage Childbearing." *American Journal of Sociology* 96: 1226-59.

Dawson, Deborah A. 1988. "Ethnic Differences in Female Overweight: Data From the 1985 National Health Interview Survey." *American Journal of Public Health* 78: 1326-29.

Denney, Justin T., Patrick M. Krueger, Richard G. Rogers, and Jason D. Boardman. 2004. "Race/Ethnic and Sex Differentials in Body Mass among U.S. Adults." *Ethnicity and Disease* 14:389-398.

DiGioacchino, Rita F., Roger G. Sargent, and Marvette Topping. 2001. "Body Dissatisfaction among White and African American Male and Female College Students." *Eating Behaviors* 2:39-50.

Downey, Liam. 2003. "Spatial Measurement, Geography, and Urban Racial Inequality." *Social Forces* 81: 937-54.

Duncan, Craig, Kelvyn Jones, and Graham Moon. 1996. "Health-Related Behavior in Context: A Multilevel Modeling Approach." *Social Science & Medicine* 42:817-30.

Durazo-Arvizu, Ramon A., Daniel L. McGee, Richard S. Cooper, Youlian Liao, and Amy Luke. 1998. "Mortality and Optimal Body Mass in a Sample of the U.S. Population." *American Journal of Epidemiology* 147: 739-49.

Farley, Reynolds and William H. Frey. 1994. "Changes in the Segregation of Whites From Blacks During the 1980's: Small Steps Toward a More Integrated Society." *American Sociological Review* 59:23-45.

Flegal, Katherine M., Margaret D. Carroll, Cynthia L. Ogden, and Clifford L. Johnson. 2002. "Prevalence and Trends in Obesity Among US adults." *Journal of the American Medical Association* 288:1723-27.

Flynn, Kristin J., and Marian Fitzgibbon. 1998. "Body Images and Obesity Risk Among Black Females: A Review of the Literature." *Annals of Behavioral Medicine* 20:13-24.

Frey, William H. and Reynolds Farley. 1996. "Latino, Asian, and Black Segregation in U.S. Metropolitan Areas: Are Multiethnic Metros Different?" *Demography* 33:35-50.

Frolich, Katherine L., Ellen Corin, and Louise Potvin. 2001. “A Theoretical Proposal for the Relationship Between Context and Disease.” *Sociology of Health and Illness* 23: 776-97.

Granovetter, Mark. 1978. "Threshold Models of Collective Behavior." *American Journal of Sociology* 83:1420-43.

Guo, Guang and Hongxin Zhao. 2000. “Multilevel Modeling for Binary Data.” *Annual Review of Sociology* 26:441-63.

Haan, Mary, George A. Kaplan, and Terry Camacho. 1987. “Poverty and Health: Prospective Evidence from the Alameda County Study.” *American Journal of Epidemiology* 125:989-98.

Hebl, Michelle R., and Todd F. Heatherton. 1998. “The Stigma of Obesity in Women: The Difference is Black and White.” *Personality and Social Psychology Bulletin* 24: 417-26.

Himes, Christine L. 2000. “Obesity, Disease, and Functional Limitation in Later Life.” *Demography* 37:73-82.

Humpel, Nancy, Neville Owen, and Eva Leslie. 2002. “Environmental Factors Associated With Adults’ Participation in Physical Activity.” *American Journal of Preventive Medicine* 22: 188-99

Jargowsky, Paul A. 1997. *Poverty and Place: Ghettos, Barrios, and the American City*. New York: Sage.

Jeffrey, Robert W. and Simone A. French. 1996. “Socioeconomic Status and Weight Control Practices Among 20 to 45-year-old Women.” *American Journal of Public Health* 86: 1005-10.

Jencks, Christopher, and Susan E. Mayer. 1990. "The Social Consequences of Growing Up in a Poor Neighborhood." Pp. 111-186 In *Inner City Poverty in the United States*, edited by Lawrence E. Lynn and Michael G.H. McGeary. Washington, D.C.: National Academy Press.

Kaplan, Deborah. 2000. "Promoting Weight Loss in the Obese Patient." *Patient Care* 34: 204-18.

Kawachi, Ichiro and Lisa F. Berkman. 2003. *Neighborhoods and Health*. New York: Oxford University Press.

Kotranski, L., J. Bolick, and J. Halbert 1987. "Neighborhood Variations in the Use of City-Supported Primary Health Care Services by an Elderly Population." *Journal of Community Health* 12: 231-45.

Krueger, Patrick M., Richard G. Rogers, Robert A. Hummer, and Jason D. Boardman. 2004. "Body Mass, Smoking, and Overall and Cause Specific Mortality among Older U.S. Adults." *Research on Aging* 26: 82-107.

Kumanyika, Shiriki K. 1993. "Special Issues Regarding Obesity in Minority Populations." *Annals of Internal Medicine* 119: 650-54.

Lakdawalla, Darius, and Tomas Philipson. 2002. "The Growth of Obesity and Technological Change: A Theoretical and Empirical Examination." *National Bureau of Economic Research Working Paper Series 8946.*

LaVeist, Thomas A. 1996. "Why We Should Continue to Study Race…But do A Better Job: An Essay on Race, Racism and Health." *Ethnicity and Disease* 6:21-9.

Lee, Rebecca E. and Catherine Cubbin. 2002. "Neighborhood Context and Youth Cardiovascular Health Behaviors." *American Journal of Public Health* 92:428-36.

Link, Bruce G. and Jo Phelan 1995. "Social Conditions as Fundamental Causes of Disease." *Journal of Health and Social Behavior* extra issue:80-94.

Littell, Ramon C., George A. Milliken, Walter W. Stroup, and Russell D. Wolfinger, 1996. *SAS System for Mixed Models* Cary, NC: SAS Institute Inc.

Macintyre, Sally and Anne Ellaway. 1998. "Social and Local Variations in the Use of Urban Neighbourhoods: A Case Study in Glasgow. *Health and Place* 4:91-4.

Macintyre, Sally and Anne Ellaway. 2003. "Neighborhoods and Health: An Overview." Pp. 20-44 in *Neighborhoods and Health* edited by Ichiro Kawachi and Lisa F. Berkman. New York: Oxford University Press.

Macintyre, Sally, Anne Ellaway, and Steven Cummins. 2002. "Place Effects on Health: How can we Conceptualize, Operationalize, and Measure Them?" *Social Science & Medicine* 55: 125-39.

Macintyre, Sally, S. Maciver, and Anne Sooman. 1993. "Area, Class and Health: Should We Be Focusing on Places or People?" *Journal of Social Policy* 22: 213-34.

Massey, Douglas S., and Nancy Denton. 1993. *American Apartheid: Segregation And The Making Of The Underclass*. Cambridge: Harvard University.

Massey, J.T., T.F. Moore, V.L. Parsons, and W. Tadros. 1989. "Design and Estimation for the National Health Interview Survey, 1985-94." National Center for Health Statistics. Vital and Health Statistics 2:110.

McCulloh, Charles E., and Shayle R. Searle, 2001. *Generalized, Linear, and Mixed Models* Wiley Series in Probability and Statistics, New York.

McGinnis, Michael, and William H. Foege. 1993. "Actual Causes of Death in the United States." *Journal of the American Medical Association* 270:2207-12.

Mokdad, Ali H., Earl S. Ford, Barbara A. Bowman, William H. Dietz, Frank Vinicor, Virginia S. Bales, and James S. Marks. 2003. "Prevalence of Obesity, Diabetes, and Obesity-Related Health Risk Factors, 2001." *Journal of the American Medical Association* 289:76-9.

Morland, Kimberly, Steve Wing, and Ana Diez-Roux. 2002. "The Contextual Effect of the Local Food Environment on Residents' Diets: The Atherosclerosis Risk in Communities Study." *American Journal of Public Health* 92:1761-7.

Must, Aviva, Jennifer Spadano, Eugenie H. Coakley, Alison E. Field, Graham Colditz, and William H. Dietz. 1999. "The Disease Burden Associated with Overweight and Obesity." *Journal of the American Medical Association* 282:1523-9.

National Center for Health Statistics. 2003. Health, United States. Hyattsville, MA.

National Health Interview Survey [computer files]. Hyattsville, Maryland: U.S. Dept. of Health and Human Services, National Center for Health Statistics [producer]. Ann Arbor, MI: Interuniversity Consortium for Political and Social Research [distributor].

O'Loughlin, Jennifer, Gilles Paradis, Natalie Kishchuk, Tracie Barnett, and Lise Renaud. 1999. "Prevalence and Correlates of Physical Activity Behaviors among Elementary School Children in Multiethnic, Low Income, Inner-city Neighborhoods in Montreal, Canada." *Annals of Epidemiology* 9:397-407.

Pastor, P.N., D.M. Makuc, C. Reuben, and H. Xia. 2002. "Chartbook on Trends in the Health of Americans. Health, United States, 2002." Hyattsville, Maryland: National Center for Health Statistics.

Perloff, Janet D., and Kim D. Jaffee. 1999. "Late Entry into Prenatal Care: The Neighborhood Context." *Social Work* 44:116–28.

Proctor, Bernadette D. and Joseph Dalaker. 2003. U.S. Census Bureau, Current Population Reports Pp60-222 in *Poverty in the United States: 2002*. Washington, DC: U.S. Government Printing Office.

Raudenbush, Stephen W. and Robert J. Sampson. 1999. "Ecometrics: Toward a Science of Assessing Ecological Settings, with Application to the Systematic Social Observation of Neighborhoods." *Sociological Methodology* 29:1-41.

Robert, Stephanie A. 1998. "Community-Level Socioeconomic Status Effects on Adult Health." *Journal of Health and Social Behavior* 39:18-37.

Robert, Stephanie A. 1999. "Socioeconomic Position and Health: The Independent Contribution of Community Socioeconomic Context." *Annual Review of Sociology* 25:489-516.

Rogers, Richard G., Robert A. Hummer, and Patrick M. Krueger. 2003. "The Effect of Obesity on Overall, Circulatory Disease, and Diabetes-Specific Mortality." *Journal of Biosocial Science* 35:107-29.

Ross, Catherine E. 2000. "Walking, Exercising, and Smoking: Does Neighborhood Matter?" *Social Science & Medicine* 51: 265-74.

Ross, Catherine E. and John Mirowsky. 2001. "Neighborhood Disadvantage, Disorder, and Health." *Journal of Health and Social Behavior* 42:258-276.

Saelens, Brian E. James F. Sallis, Jennifer B. Black, and Diana Chen. 2003. "Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation." *American Journal of Public Health* 93:1552-8.

Schoenborn, Charlotte A., Patricia F. Adams, and Patricia M. Barnes. 2002. "Body Weight Status of Adults: United States, 1997- 1998." Advance Data from Vital and

Health Statistics; no. 330. Hyattsville, Maryland: National Center for Health Statistics.

Schoenborn, Charlotte A., Patricia F. Adams, and Jeannine S. Schiller. 2003. "Summary Health Statistics for the U.S. population: National Health Interview Survey, 2000." National Center for Health Statistics. Vital and Health Statistics 10: 214.

Scribner, Richard A., D. Cohen, S. Kaplan, and S.H. Allen. 1999. "Alcohol Availability and Homicide in New Orleans: Conceptual Considerations for Small Area Analysis of the Effect of Alcohol Outlet Density." *Journal of Studies of Alcohol* 60:310-16.

Snijders, Tom A., and Roel J. Bosker. 1999. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*. Thousand Oaks: Sage Publications.

Sooman, Anne, Sally Macintyre, and A. Anderson. 1993. "Scotland's Health: A More Difficult Challenge for Some? The Price and Availability of Health Foods in Socially Contrasting Localities in the West of Scotland." *Health Bulletin* 51:276-84.

Stevens, June, Shiriki K. Kumanyika, and Julian E. Keil. 1994. "Attitudes Towards Body Size and Dieting: Differences Between Elderly Black and White Women." *American Journal of Public Health* 84:1322-25.

Stewart, A. L. 1982. "The Reliability and Validity of Self-Reported Weight and Height." *Journal of Chronic Disease.* 35: 295-302.

Sturm, Roland. 2002. "The Effects of Obesity, Smoking, and Drinking on Medical Problems and Costs." *Health Affairs* 21:247-53.

Sundquist, Jan, and Sven-Erik Johansson. 1998. "The Influence of Socioeconomic Status, Ethnicity, and Lifestyle on Body Mass Index in a Longitudinal Study." *International Journal of Epidemiology* 27:57-63.

Tienda, Marta. 1991. "Poor People and Poor Places: Deciphering Neighborhood Effects on Poverty Outcomes" Pp. 244-262 *Macro-Micro Linkages in Sociology* edited by Joan Huber. Newbury Park: Sage.

Troutt, David D. 1993. *The Thin Red Line: How the Poor Still Pay More."* Oakland, CA: Consumers Union.

Wang, Guijing Wang, Zhi-Jie Zheng, Gregory Heath, Carol Macera, Mike Pratt and David Buchner. 2002. "Economic Burden of Cardiovascular Disease Associated with Excess Body Weight in U.S. Adults." *American Journal of Preventive Medicine* 23:1-6.

Weinsier, Roland L., Gary R. Hunter, Adrian F. Heini, Michael I. Goran, and Susan M. Sell. 1998. "The Etiology of Obesity: Relative Contribution of Metabolic Factors, Diet, and Physical Activity." *American Journal of Medicine* 105:145-50.

Wells, Barbara L., and John W. Horm. 1998. "Targeting the Underserved for Breast and Cervical Cancer Screening: The Utility of Ecological Analysis using the National Health Interview Survey." *American Journal of Public Health* 88:1484-9.

Whitaker, Robert C. 2002. "Understanding the Complex Journey to Obesity in Early Adulthood." *Annals of Internal Medicine* 136:923-25.

Williams, David R. 1996. "Racism and Health: A Research Agenda (Editorial)." *Ethnicity and Disease* 6:1-8.

Williams, David R. 1997. "Race and Health: Basic Questions, Emerging Directions." *Annals of Epidemiology* 7:322-33.

Williams, David R., and Chiquita Collins. 1995. “U.S. Socioeconomic and Racial Differences in Health: Patterns and Explanations.” *Annual Review of Sociology* 21: 349-86.

World Health Organization. 1997. “Obesity: Preventing and Managing the Global Epidemic.” Geneva: World Health Organization.

Wyke, S., G. Campbell, and S. McIver. 1992. “The Provision of Primary Care Services in a Working Class and Middle Class Locality in Glasgow.” *British Journal of General Practice* 42:271-75.

Yen, I.H. and S.L. Syme. 1999. "The Social Environment and Health: A Discussion of the Epidemiologic Literature." *Annual Review of Public Health* 20:287-308.

Table 1. Obesity Prevalence Rates by Racial and Socioeconomic Characteristics of Respondent's Neighborhoods

	Total	Racial Composition		Socioeconomic Composition		Poor Areas		Non-Poor Areas	
		Non-black areas	Black areas	Non-poor areas	Poor Areas	Non-black areas	Black Areas	Non-black areas	Black areas
Obesity Prevalence									
0-5%	12.3	14.3	3.4	13.4	5.7	10.2	1.5	14.6	4.7
5-10%	19.9	22.3	8.9	21.4	10.7	14.8	7.0	22.6	10.2
10-15%	22.4	24.1	14.5	23.9	13.5	19.3	8.2	24.5	18.9
15-20%	17.8	18.1	16.2	18.0	16.4	19.7	13.5	18.0	18.1
20-25%	12.9	11.5	19.5	12.2	16.8	13.8	19.5	11.8	19.4
>25%	14.7	9.8	37.6	11.1	36.9	22.2	50.3	8.5	28.6
Average	14.7	13.3	21.6	13.7	20.9	16.8	24.6	12.9	19.4
S.D.	9.2	8.3	10.0	8.5	10.7	9.7	10.1	8.1	9.4
N	7953	6544	1409	6840	1113	528	585	6016	824

Note: Neighborhood-level data only. Cell entries represent column specific percentages.

Source: 1990-1994 NHIS.

Table 2. Descriptive Statistics for all Variables Used in Multivariate Analyses

	Black Respondents	White Respondents
Obese	22.8	13.6
Sociodemographic Characteristics		
Age		
18-29	27.5	21.2
30-49	42.8	40.6
50-69	20.7	23.6
70+	8.9	14.6
Male	41.26	46.51
Education		
Less than High School	29.2	19.3
High School Education	38.3	37.5
Greater than High School Education	32.5	43.2
Poor	24.1	9.1
Neighborhood Characteristics		
Black Area (>25% Black)	76.4	5.7
Poor Area (>25% Poor)	36.4	9.3
Obese Area (>25% Obese)	31.9	10.4
Sample Size	30891	183154

Note: Cell entries represent percents. All data have been weighted. Bivariate tests of association indicate statistically significant differences in the distribution of all variables among white and black respondents. Source: 1990-1994 NHIS.

Table 3. Odds-ratios: Individual and Neighborhood-level Risk Factors Associated with Obesity Among Adults

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Sociodemographic Characteristics						
Racial Identification [NH White]						
NH Black		1.88 ***	1.73 ***	1.59 ***	1.58 ***	1.55 ***
Age [18-29]						
30-49			1.82 ***	1.82 ***	1.84 ***	1.81 ***
50-69			2.10 ***	2.10 ***	2.12 ***	2.10 ***
70+			1.18 ***	1.18 ***	1.19 ***	1.19 ***
Sex [Female]						
Male			0.95 ***	0.95 ***	0.95 ***	0.95 ***
Education [More than High School]						
High School Dropout			1.71 ***	1.70 ***	1.68 ***	1.55 ***
High School Education			1.35 ***	1.35 ***	1.34 ***	1.27 ***
Poverty Status [Not poor]						
Poor			1.36 ***	1.36 ***	1.31 ***	1.30 ***
Neighborhood Characteristics						
Racial Composition [<25% NH Black]						
≥ 25% NH Black				1.13 ***	1.09 **	1.01
Socioeconomic Composition [<25% Poor]						
≥ 25% Poor					1.15 **	1.11 ***
Body Mass Composition [<5% Obese]						
5-10% Obese						1.27 ***
10-15% Obese						1.34 ***
15-20% Obese						1.62 ***
20-25% Obese						1.68 ***
>25% Obese						1.77 ***
σ^2_u	0.30	0.26	0.25	0.23	0.21	0.00
ρ	0.08	0.07	0.07	0.07	0.06	0.00
-2 Log Likelihood	178627.34	177218.4	173824.19	173796.67	173744.83	173070.4
Likelihood Ratio Test		1408.94***	3394.21***	27.52***	51.84***	674.43***

Note: Cell entries represent odds ratios and 95% confidence intervals in parentheses. Source: 1990-1994 NHIS. *** $p < .001$, ** $p < .01$, * $p < .05$