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Tract- and County-Level Income Inequality and Individual Risk of Obesity in the United States

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Abstract

Objectives—We tested three alternative hypotheses regarding the relationship between income inequality and individual risk of obesity at two geographical scales: U.S. Census tract and county.

Methods—Income inequality was measured by Gini coefficients, created from the 2000 U.S. Census. Obesity was clinically measured in the 2003–2008 National Health and Nutrition Examination Survey (NHANES). The individual measures and area measures were geo-linked to estimate three sets of multi-level models: tract only, county only, and tract and county simultaneously. Gender was tested as a moderator.

Results—At both the tract and county levels, higher income inequality was associated with lower individual risk of obesity. The size of the coefficient was larger for county-level Gini than for tract-level Gini; and controlling income inequality at one level did not reduce the impact of income inequality at the other level. Gender was not a significant moderator for the obesity-income inequality association.

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Conclusions—Higher tract and county income inequality was associated with lower individual risk of obesity, indicating that at least at the tract and county levels and in the context of cross-sectional data, the public health goal of reducing the rate of obesity is in line with anti-poverty policies of addressing poverty through mixed-income development where neighborhood income inequality is likely higher than homogeneous neighborhoods.

Keywords

income inequality; obesity; neighborhood; Census tract; county; NHANES

Introduction

Area economic inequality has been theorized to have an influence on health in addition to the level of individual and area aggregate income, although the currently available evidence suggests that the relationship is inconsistent. Lynch et al (2004) reviewed 98 aggregate and multilevel studies and concluded that there seemed to be "little support for the idea that income inequality is a major, generalizable determinant of population health differences within or between rich countries." Wilkinson & Pickett (2006), on the other hand, identified 168 studies and concluded that "a large majority(70 percent) suggested that health is less good in societies where income differences are bigger." Leigh, Jencks, and Smeeding (2009) noted that although most studies of health and inequality found no significant relationship, the confidence intervals in many studies included both positive and negative values large enough to be of considerable practical importance. They concluded that "achieving more consensus will require more work with better data and better methods than have been usual in the past."

A theoretical paradox exists regarding the relationship between income inequality and health. The hypotheses that economic inequality is detrimental to health can be classified into three groups (Leigh et al., 2009): the absolute income, the relative income, and the society-wide ill effects of inequality. The absolute income hypothesis posits that holding total area income constant, an income transfer from the richer person to the poorer person raises the health of the poorer person more than it lowers the health of the richer person due to diminishing marginal return. As such, a decrease in income inequality would improve the health of the poorer, worsen the health of the richer but to a smaller extent, and improve the average health of the population. However, there should be no relationship between income inequality and individual health if individual income is controlled appropriately. The relative income hypothesis suggests that holding individual income constant, people's health is affected by their relative income compared to others, and upward comparisons are likely more stressful than downward comparisons. The society-wide ill effect perspective contends that high levels of income inequality can increase amounts of social problems such as lack of social cohesion and trust, disinvestment in public goods, and increased violent crime (Lynch et al., 2001; Wilkinson, 1996). These social ills can lead to poor health via elevated stress and unhealthy lifestyles for many individuals in the society (Kawachi & Kennedy, 1999; Wilkinson, 1992).

By contract, a different line of research, mostly focused on small area neighborhood effects on residents' outcomes such as educational achievement, proposes that neighborhood income inequality, in the form of the presence of affluence in otherwise homogeneously-poor neighborhoods, may be beneficial to the residents (Jencks & Mayer, 1990). It is argued that the more affluent residents can provide role models for mainstream social norms and uphold neighborhood institutions, and therefore increase the wellbeing of the poorer. The existence of wealth also provides the tax base needed in the neighborhood to provide better neighborhood infrastructure (Wilson, 1987, 1996). In fact, the rationale for mixed-income housing development as a strategy to combat urban poverty is built on the idea that low-income residents may achieve a better life through greater informal social control and access to higher quality services when moving from homogeneous poor neighborhoods to mixed-income neighborhoods with higher income inequality (Joseph, Chaskin, & Webber, 2007).

Empirically, a variety of health outcomes have been examined, including all-cause mortality, age-specific mortality, homicide, low birth weight, disability, smoking, and self-rated health, with mixed results. A detrimental relationship of income inequality on health was most consistently found for large-area aggregate measures in ecological analysis, such as country- or state-level income inequality and mortality and morbidity outcomes. However, such ecological analyses have been criticized as suffering from the problem of ecological fallacy (Ellison, 2002; Gravelle, 1998; Rodgers, 1979). Indeed, evidence on the association between income inequality and health for small rather than large areas, and for individual outcomes rather than aggregate outcomes, was less consistent (Auger, Zang, & Daniel, 2009; Lynch et al., 2004; Wilkinson & Pickett, 2006). Small area and/or individual outcome studies found income inequality to have no significant relationship to health after appropriate controls (Wen, Browning, & Cagney, 2003), detrimental relationship to health (Lopez, 2004), and beneficial relationship to health (Bjornstrom, 2011).

Focusing on BMI or obesity as the health outcome, ecological studies of developed countries found that, adjusting for gross national per capita income, income inequality was positively correlated with prevalence of obesity among adult men and women (Kim, Kawachi, Hoorn, & Ezzati, 2008; Pickett, Kelly, Brunner, Lobstein, & Wilkinson, 2005) and with mean BMI (Kim et al., 2008). Multi-level analyses showed that state-level income inequality was associated with increased individual risk of obesity for women but not men (Diez Roux, Link, & Northridge, 2000), and with increased risk of abdominal weight gain at waist for men but not women (Kahn, Tatham, Pamuk, & Heath Jr, 1998).

Small area empirical evidence was mixed. Supporting the hypothesis that income inequality is detrimental to health, Robert and Reither (2004) reported that tract-level income inequality was positively related to BMI for women but not men, using data from the 1986 American's Changing Lives Study combined with the 1980 census. However, other studies found no relationship between income inequality and weight outcome, including Mobley et al. (Mobley et al., 2006) using 2000–2001 data of uninsured low-income women and county-level income inequality, and Chang and Christakis (2005) using data from the Behavioral Risk Factor Surveillance System (BRFSS) and metropolitan income inequality. Still other studies found beneficial relationships between income inequality and weight outcomes, including Bjornstrom (2011) using Los Angeles data and tract-level economic inequality, Kling et al (2004) using randomized experimental data from the Moving to Opportunity project in five large U.S. cities, and Chen & Crawford (2012) using BRFSS data and state- and county-level income inequality, although Chen & Crawford (2012) also found that higher across-county income inequality was linked to higher risk of obesity.

In sum, the existing literature on income inequality and individual body weight has been quite limited with mixed results. Ecological studies tended to show a detrimental effect of income inequality on aggregate BMI or prevalence of obesity, while multi-level studies found positive, negative, or no association between income inequality and weight outcome. All studies used self-reported weight and height data, which tended to underestimate BMI and the rate of obesity. Answering the call by Leigh et al. (2009) of utilizing better quality data to analyze the relationship between income inequality and health, this study aimed to contribute to the debate by analyzing multiple waves of the National Health and Examination Survey (NHANES) data geo-linked at the Census tract-level and county level to Census data. Compared with previous studies, our data allowed for a better obesity measure, a more extensive list of relevant individual-level control variables, and better generalizability (Centers for Disease Control and Prevention, 2013). In addition, investigating tract-level and county-level income inequality independently and simultaneously allowed for an assessment of how income inequality at different geographical scales might be differentially related to individual weight outcome.

Based on existing theories discussed earlier, three alternative hypotheses were developed:

> H1. If the relative income hypothesis and the society-wide effects theory dominate, then higher community income inequality would be associated with higher individual risk of obesity, other things controlled.
>
> H2. If the theory of the benefit of the affluence dominates, then higher community income inequality would be associated with lower individual risk of obesity, other things controlled.
>
> H3. If the absolute income hypothesis dominates, or if the impact of relative income/society wide ill and benefit of the affluence cancels out each other, then community income inequality would not be associated with individual risk of obesity, other things controlled.

As the literature suggests that gender may be an important moderator for the association between obesity risk and neighborhood income inequality (Böckerman, Johansson, Helakorpi, & Uutela, 2009; Chen & Crawford, 2012; Robert & Reither, 2004), gender was investigated as a potential moderator in these hypothesized relationships.

Data

Data from the NHANES were used for this research. NHANES is a program of studies designed to assess the health and nutritional status of the civilian, noninstitutionalized United States population. These surveys have been conducted by the National Center for Health Statistics (NCHS) and became a continuous program in 1999, examining a nationally representative sample of approximately 5,000 persons each year. These persons are located in counties across the United States, 15 of which are visited each year. The NHANES combines personal interviews and physical examinations. For this study, adults 20–64 from NHANES 2003–2008 were selected because the relationship may be significantly different for children and for older adults (Backlund et al., 2007). Including multiple years of NHANES allowed for a large geographical representation. Tract-level and county-level data came from the 2000 Census and were geo-linked to NHANES by staff at the Centers for Disease Control and Prevention (CDC) Research Data Center. The researchers had no access to information that could potentially identify the survey subjects. The study was approved by the University of Utah Institutional Review Board.

The 2003–2008 NHANES had 11,716 adults aged 20–64. Additional sequential exclusions included: pregnancy (n=626), underweight with BMI less than 18.5 (n=182), extreme obese with BMI > 60 (n=24) (Brown et al., 2013), missing BMI data (n=576), and missing linked tract information (n=6). Participants with and without BMI and tract data had similar age, gender, and race/ethnicity distributions. The final sample size was 10,302, including 5,079 women and 5,223 men.

Measures and Analytical Methods

Obesity was measured by a categorical variable indicating obesity status (BMI ≥ 30) based on clinically measured BMI. Income inequality was measured by tract-level Gini coefficient and county-level Gini coefficient, constructed from the 2000 U.S. Census Population and Housing Summary File (Kennedy, Kawachi, & Prothrow-Stith, 1996). The Gini coefficient is a measure of statistical dispersion intended to represent the income distribution of an area's residents, and is one of the widely used measures in the literature on income inequality and health (Chen & Crawford, 2012). The Gini coefficient has the following mathematical form:

$$G=\frac{2}{n^2\bar{y}}\sum_{i=1}^{n} iy_i-\frac{n+1}{n}$$

Where y is a measure of income with sample mean $\bar{y}$, n is the total number of observations, and i is the rank of y_i in the income distribution. A higher Gini coefficient implies a higher level of area income inequality.

The 2000 U.S. Census Population and Housing summary file provided annual household before-tax income data for 25 income intervals. Counts of the number of households that fell into each income interval were obtained for each census tract and each county. The Gini coefficient was constructed from these grouped income data using a program developed in Stata (Whitehouse, 1995).

Individual covariates based on past research included age (log-transformed to account for nonlinearity and heteroscadesticity) (Ravussin & Bogardus, 1989), marital status (Sobal, Rauschenbach, & Frongillo Jr, 1992), education (Hermann et al., 2011), race/ethnicity (Ogden et al., 2006), US-born (Sanchez-Vaznaugh, Kawachi, Subramanian, Sánchez, & Acevedo-Garcia, 2008), family size (Weng, Bastian, Taylor Jr, Moser, & Ostbye, 2004), income-to-poverty ratio (log-transformed) (Drewnowski & Specter, 2004), and dummies controlling for survey year. Missing data on income-to-poverty ratio (n=653) were imputed by substituting the mean plus a random error component corresponding to the distribution for year-specific nonmissing values (Brown et al., 2013). In addition, tract- and county-level median household incomes (log-transformed) were controlled.

To analyze the relationship between tract-level and county-level Gini coefficients and individual risk of obesity, three sets of models were estimated: (1) tract level only, (2) county level only, and (3) both tract and county levels. Tests for multicollinearity among independent variables revealed no problematic issues with the Variance Inflation Factor (VIF) ranged from 1.01 to 2.11 and the largest condition index value at 3.31. Analyses were conducted remotely using SAS 9.2 on the secured server at the Research Data Center (RDC) at Center for Disease Control and Prevention (CDC). For descriptive statistics, Proc Surveymeans was used to account for NHANES's complex sample design. For multivariate analysis, because SAS 9.2 did not have a procedure that could account for both complex sample design of NHANES and multilevel modeling simultaneously, each model was estimated using both methods, with Proc Surveylogistic correcting for the complex sample design of NHANES and Proc Glimmix for random intercept multilevel models. For the survey models the NHANES MEC weights adjusting for 6 years of data were computed and used. Proc Glimmix models were not weighted as recommended by Carle (Carle, 2009), because the SAS 9.2 Glimmix procedure was not designed to handle complex survey weights correctly. Analyses were performed first for the whole sample and then separately by gender. Full-interaction models, where gender was interacted with all independent variables, were estimated to test the statistical significance of gender as a moderator.

Results

Table 1 presents weighted descriptive statistics. The obesity rate of 36.3% for women and 32.5% for men were in line with national estimates, and this gender difference is statistically significant at conventional levels. The mean Census tract Gini was 38.3, while the mean county-level Gini was higher at 41.6, likely because Census tracts were delineated to be socioeconomically homogenous while counties were not. Median household income was about $45,300 for tracts and $43,000 for counties in 2000. Gender difference was significant for most individual level variables with the exception of percentage of college or more education and percentage of other races. Specifically, compared to adult men, adult women had slightly higher mean age but smaller average family size and lower income-to-poverty ratio. A slightly smaller percentage of women than men were married, were Hispanic, and had less than high school education. On the other hand, a light higher percentage of women than men were black, and had graduated from high school or had some college education. All survey year indicators and tract- and county-level variables were not significantly different between the genders.

Table 2 presents the estimated coefficients of Gini's on individual risk of obesity. The estimates were very consistent between the models correcting for complex survey design (Proc Surveylogistic) and the unweighted random intercept multilevel models (Proc Glimmix), with the same sign for all estimates. In cases where the coefficients on income inequality and median tract income variables were different, Proc Surveylogistic models always had slightly larger estimates than Proc Glimmix. We chose to presents the more conservative results from the multilevel models (Table 2). Results from the survey design models are available from the authors upon request.

All models showed a negative association between income inequality and individual risk of obesity, indicating that higher income equality was associated with lower risk of obesity for residents, controlling for the list of individual and neighborhood characteristics discussed earlier. Among the 12 estimated coefficients for Gini coefficients, all except for two were statistically significant at conventional levels. The two exceptions were tract Gini coefficients for women, where the sign of the coefficients was still negative yet conventional statistical significance was not reached. Considering that the combined gender models showed both tract and county Gini's to be statistically significant and gender differences to be statistically insignificant at conventional levels, our results points to a "beneficial" relationship between income inequality and risk of obesity was consistent across both geographic scales and across genders. County-level Gini's had substantially larger coefficients compared with tract-level Gini's. An one unit increase in tract-level Gini (e.g., from 38 to 39) was associated with a 1% lower odds of obesity for women and a 2% lower odds of obesity for men, while a 1% increase in county-level Gini was associated with a 4% lower odds of obesity for both genders. The effects of tract-level and county-level Gini's appear to be additive, in that controlling one did not reduce the impact of the other. Both tract-level and county-level median household income were associated with lower individual risk of obesity. Gender difference for income inequality was mostly statistically insignificant with the exception of county-level Gini in the county-only model, with the coefficient for men slightly larger in size than that for women. On the other hand, gender differences in the relationship between obesity risk and area median household income was statistically significant for all models except for the county-only model. Tract-level median household income was associated with a larger reduction of obesity risk for women than men, while county median household income was associated with a slightly smaller reduction of obesity risk for women than men.

Table 3 presents full estimates of the three-level random intercept models including both tract- and county-level Gini and median household income. Age, family size, being black or Hispanic, and being U.S.-born were associated with higher risk of obesity, whereas being male and college-educated were associated with lower risk of obesity. When models were estimated separately by gender, findings show that being married was associated with lower risk of obesity for women but higher risk of obesity for men, and a higher income-to-poverty ratio was associated with higher risk of obesity for men but not women. In addition, college or more education is associated with a larger reduction of obesity risk for women than men, while being black was associated with a larger obesity risk for women than men.

Discussion and Conclusion

The purpose of this research was to ascertain the relevance of tract-level and county-level income inequality to individual risk of obesity while controlling for individual income, neighborhood income, and other health-related individual characteristics. We found that at both the tract- and county-levels, higher income inequality, as indicated by larger Gini coefficients, was associated with lower risk of obesity for area residents. These findings reject Hypotheses 1, which predicts that higher area income inequality should be related to a higher risk of obesity for area residents based on theories of relative income hypothesis and society-wide ill effects of income inequality. These findings also reject Hypothesis 3, which predicts that area income inequality should not be associated with individual risk of obesity based on the absolute income hypothesis.

Our findings support Hypothesis 2, which predicts that higher area income inequality is associated with lower individual risk of obesity, based on the theory of the benefit of the affluence present in the area. Our findings are consistent with Bjornstrom (Bjornstrom, 2011) and Kling et al (Kling et al., 2004), which found higher tract-level neighborhood income inequality to be associated with lower risk of obesity for a Los Angles sample and a five-city randomized trial HUD sample, respectively. Our findings are also consistent with Chen & Crawford (Chen & Crawford, 2012)'s finding that higher county- and state-level income equality were associated with lower individual risk of obesity, although they also found that higher cross-county Gini were associated with higher individual risk of obesity, of which we did not investigate. Our findings are, however, in contrast to Robert and Reither's findings using the 1986 Current Population Survey. It is possible, as Bjorstrom suggested, that there may have been fundamental changes in the physical and/or social characteristics of neighborhoods since that time given the increase in gentrification of urban neighborhoods. Bjornstrom also tried to reconcile her results with Robert and Reither's results by speculating that Los Angeles County in her study might differ from national norms. However, our findings using NHANES data show that such relationship is national, and so were Chen and Crawford's findings with the BRFSS data.

We also found that while gender moderates the association between obesity risk and many individual-level variables and area median household income, it is not a significant moderator for the relationship between area income inequality and obesity in our tract-only model and combined tract-and-county model. Past studies found the existence of significant gender difference in the relationship between area income inequality and some but not all health outcomes and health behavior (Böckerman et al., 2009; Chen & Crawford, 2012; Robert & Reither, 2004). Our results show that obesity risk is a health outcome that does not exhibit a significant gender difference in its relationship with neighborhood income inequality. As such, our discussion of the results focuses on the combined results for both genders instead of men and women separately.

One issue worth noting is that while high area income inequality may appear to be a "bad" thing from a social justice perspective, in the context of cross-sectional data and small areas such as Census tracts, it is not necessarily detrimental. In fact, in the cross-sectional and small area context, a high income inequality is likely associated with mixed-income neighborhoods instead of homogeneous neighborhoods. There is a large literature providing both theoretical and empirical investigations of addressing poverty through mixed-income development (Joseph et al., 2007). This literature has concluded that the most compelling propositions are those suggesting that some low-income residents may benefit from a higher quality of life through greater informal social control and access to higher quality services when they live in mixed-income neighborhoods with some higher income residents routinely present. There was less evidence that socioeconomic outcomes for low-income residents may be improved through social interaction, network building, and role modeling. While testing the underlying mechanisms of our findings is beyond the scope of this study, we believe future research should explore these mechanisms in order to gain better understanding of the relationship between neighborhood income inequality and health outcomes.

It is important to note that area income inequality is a contextual variable, and as such, the geographical scale at which the inequality is measured may have different interpretations and relate to social factors differently. A rejection of the income inequality hypothesis at the tract- and county-levels cannot negate affirmative evidence at higher aggregation levels, such as state and country levels (Chen & Crawford, 2012; Rostila, Kölegård, & Fritzell, 2012).

Several caveats need to be kept in mind when interpreting these findings. First, self-selection could be an issue because it was possible that certain type of people were more likely to choose mixed-income neighborhoods than homogenous neighborhoods, and such propensity to live in mixed-income neighborhoods could be correlated with factors associated with risks of obesity. We were unable to correct for self-selection bias using statistical methods such as instrumental variables approach because our statistical tools were limited by software availability at RDC. However, while the literature investigating the impact of neighborhood self-selection on obesity risk disagrees on whether corrections lead to higher or lower coefficient estimates of neighborhood effects, it generally agrees that the effects are still significant and remain in the same direction after such corrections (Zick et al., 2013). As such, while the size of our estimates may be affected, the direction and significance level of our estimates are likely to remain the same. Second, due to data limitations, our Gini coefficients did not adjust for taxes and transfer programs, and as such, the actual income inequality was likely somewhat lower than what our measures would reflect, and the size of such discrepancies may vary for different tracts and counties.

Nevertheless, our study has several advantages. First, our weight and height measures were objective, leading to a more valid measure of risk of obesity compared with subjective measures. Second, our study used a nationally representative sample of non-institutionalized civilian population, leading to our results being more generalizable than many previous studies using smaller geographical areas. Third, we were able to control for an extensive list of variables, which many previous studies were not able to do due to data limitations. Forth, we simultaneously modeled the inequality-obesity relationship at two geographical levels, which allowed us to explore differential associations between income inequality and obesity under different geographical aggregations. Very few studies exploring the relationship between income inequality and health simultaneously estimated the relationship at more than one aggregation level.

In conclusion, this study examined the association between tract-level and county-level income inequality and residents' individual risk of obesity while controlling for individual income, neighborhood income, and other health-related individual characteristics. We found that at both the tract and county levels, higher income inequality, as measured by area Gini coefficients, was associated with lower risk of obesity for area residents. The findings support the prediction generated from Wilson's theory of the benefit of neighborhood affluence (Wilson, 1987, 1996). Our study implies that at least at the tract and county levels and in the context of cross-sectional data, the public health goal of reducing the rate of obesity is in line with anti-poverty policies of addressing poverty through mixed-income development where neighborhood income inequality is likely higher than homogeneous neighborhoods.

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Highlights

- Higher tract-level income inequality and higher county-level income inequality are independently associated with lower individual risk of obesity for residents.
- The size of association between income inequality and obesity risk is larger for county-level than tract-level income inequality.
- Gender is not a significant modifier of the income inequality and obesity risk relationship at the tract and county levels.

Table 1

Weighted descriptive statistics: NHANES 2003–2008 adults 20–64

	Both genders		Women (n=5,079)		Men (n=5,223)		Gender difference significance
	Mean	S.E.	Mean	S.E.	Mean	S.E	
Individual level variables							
Obese	34.4%	0.9%	36.3%	0.9%	32.5%	1.1%	***
Age	41.3	0.2	41.7	0.2	40.8	0.3	***
Married	65.9%	1.0%	64.0%	1.1%	67.7%	1.1%	***
Family size	3.2	0.0	3.2	0.0	3.2	0.0	***
Less than high school	16.6%	0.8%	15.3%	0.8%	18.0%	0.9%	***
Some college	32.3%	0.7%	34.6%	0.9%	30.0%	0.8%	***
College or more	26.0%	1.2%	26.5%	1.2%	25.5%	1.4%	
Black	11.9%	1.1%	12.8%	1.3%	10.9%	1.0%	***
Hispanic	13.3%	1.2%	12.5%	1.1%	14.1%	1.2%	***
Other race	6.0%	0.6%	6.0%	0.6%	6.0%	0.6%	
US born	83.4%	1.4%	84.9%	1.2%	81.9%	1.5%	***
Income/needs ratio	3.1	0.0	3.1	0.1	3.2	0.0	***
Survey year 2003–2004	32.4%	1.7%	32.5%	1.8%	32.2%	1.7%	
Survey year 2005–2006	33.1%	1.7%	33.0%	1.8%	33.3%	1.7%	
Survey year 2007–2008	0.35	0.02	0.35	0.02	0.35	0.02	
Tract-level variables							
Tract Gini (%)	38.3	0.2	38.3	0.2	38.3	0.2	
Tract median household income ($1,000)	45.3	1.1	45.2	1.1	45.4	1.1	
County-level variables							
County Gini (%)	41.6	0.3	41.6	0.3	41.6	0.3	
County median household income ($1,000)	43.0	1.0	42.8	1.0	43.1	1.0	

*** p<0.01,

** p<0.05,

* p<0.1

Table 2

Parameter estimates for Gini: Multi-level logistic regression models on the odds of being obese, NHANES 2003–2008 adults 20–64.

	Both genders				Women				Men				
Variables	**Coef.**	**Odds ratio**	**t-value**	**P-value**	**Coef.**	**Odds ratio**	**t-value**	**P-value**	**Coef.**	**Odds ratio**	**t-value**	**P-value**	**Gender difference significance**
Tract and county													
Tract Gini (%)	−0.02	0.98	−2.73	***	−0.01	0.99	−1.20		−0.02	0.98	−2.59	***	
Tract household income (log, in $1,000)	−0.29	0.75	−3.45	***	−0.37	0.69	−3.25	***	−0.18	0.83	−1.58		***
County Gini (%)	−0.04	0.96	−2.85	***	−0.04	0.96	−2.58	***	−0.04	0.96	−2.31	**	
County median income (log, in $1,000)	−0.52	0.59	−3.17	***	−0.46	0.63	−2.29	***	−0.65	0.52	−2.98	***	**
Tract only													
Tract Gini (%)	−0.02	0.98	−3.03	***	−0.01	0.99	−1.60		−0.02	0.98	−2.79	***	
Tract household income (log, in $1,000)	−0.40	0.67	−5.35	***	−0.46	0.63	−4.58	***	−0.33	0.72	−3.21	***	**
County only													
County Gini (%)	−0.04	0.96	−3.48	***	−0.04	0.96	−2.81	***	−0.05	0.95	−2.96	***	**
County median income (log, in $1,000)	−0.68	0.51	−4.72	***	−0.72	0.49	−4.03	***	−0.70	0.50	−3.68	***	

All equations are three-models controlling for individual age, gender, marital status, family size, education, race/ethnicity, nativity, and survey year.

*** $p<0.01$,

** $p<0.05$,

* $p<0.1$

Table 3

Parameter estimates for the full models with both tract and county level variables: NHANES 2003–2008 adults 20–64.

	Both genders			Women			Men			
Individual level variables	**Coef.**	**t-value**		**Coef.**	**t-value**		**Coef.**	**t-value**		**Gender difference significance**
Age (log)	0.76	10.86	***	0.90	9.10	***	0.52	5.12	***	***
Male	−0.31	−7.36	***							
Married	0.02	0.42		−0.14	−2.14	**	0.29	3.97	***	***
Family size	0.05	3.37	***	0.06	2.63	***	0.04	1.84	*	
Less than high school	−0.07	−1.18		0.00	0.03		−0.14	−1.54		
Some college	0.02	0.34		−0.01	−0.07		0.04	0.49		
College or more	−0.29	−4.20	***	−0.46	−4.66	***	−0.16	−1.60		**
Black	0.50	7.96	***	0.67	7.59	***	0.33	3.73	***	***
Hispanic	0.49	6.72	***	0.54	5.53	***	0.43	4.17	***	
Other race	−0.17	−1.40		−0.25	−1.42		−0.10	−0.60		
US-born	0.58	8.45	***	0.58	6.08	***	0.56	5.72	***	
Income-to-poverty ratio (log)	0.02	0.71		−0.04	−1.20		0.12	2.90	***	***
Survey year 2003–2004	−0.12	−1.80	*	−0.12	−1.46		−0.12	−1.36		
Survey year 2005–2006	−0.01	−0.17		0.04	0.44		−0.02	−0.27		
Tract-level variables										
Tract Gini (%)	−0.02	−2.73	***	−0.01	−1.20		−0.02	−2.59	***	
Tract median household income (log, in $1,000)	−0.29	−3.45	***	−0.37	−3.25	***	−0.18	−1.58		***
County-level variables										
County Gini (%)	−0.04	−2.85	***	−0.04	−2.58	***	−0.04	−2.31	**	
County median household income (log, in $1,000)	−0.52	−3.17	***	−0.46	−2.29	***	−0.65	−2.98	***	**

*** p<0.01,

** p<0.05,

* p<0.1