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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 geolinked 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.

**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.

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## 1. 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 and 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 et al. \(2009\)](#) noted that although

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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 and Kennedy, 1999; Wilkinson, 1992).

By contrast, 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 and 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 et al., 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 et al., 2009; Lynch et al., 2004; Wilkinson and Pickett, 2006). Small area and/or individual outcome studies found income inequality to have no significant relationship to health after appropriate controls (Wen et al., 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 et al., 2008; Pickett et al., 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 et al., 2000), and with increased risk of abdominal weight gain at waist for men but not women (Kahn et al., 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. (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 and Crawford (2012) using BRFSS data and state- and county-level income inequality, although Chen and Crawford (2012) also found that higher cross-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 and county levels 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:

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