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Short communication

# BMI, auto use, and the urban environment in San Francisco

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**Abstract**

The epidemic of overweight and obesity has sparked interest in urban planning circles. Many believe the built environment directly influences physical health, and recent empirical evidence supports this notion. Cross-sectional survey data was collected from a sample of San Francisco residents ($n = 670$) in the summer of 2005. Body mass index (BMI) served as the dependent variable. Independent variables included population density and auto use. Results indicate an inverse relationship between density and auto use as well as higher BMI scores for respondents reporting high levels of auto use for the work/school commute and trips to the grocery store.


*Keywords:* United States; San Francisco; Public health; Obesity; Urban planning; Urban form

## Introduction

Despite the debate over the actual number of deaths attributable to obesity and overweight, the epidemic remains a major public health concern (Couzin, 2005; Flegal et al., 2005; Hu et al., 2005; Marks, 2005). Numerous researchers have implicated the physical environment for low physical activity levels and sedentary lifestyles, both commonly thought to contribute to obesity and overweight (Berrigan and Troiano, 2002; Brownson et al., 2001; Handy et al., 2002; Jackson, 2003; Kreyling and Ketcham, 2001). This a priori assumption came at a time when Frank and Engelke (2001) asserted that urban planners could facilitate physical activity, and possibly improve public health, through construction of a built environment favoring behaviors like walking and biking over the use of an automobile. Since then, numerous empirical studies have demonstrated a statistical link between urban form, auto use, and body mass index (BMI) (Ewing et al., 2003; Frank et al., 2004; Lopez, 2004; Saelens et al., 2003a).

Ewing et al. (2003) were the first to connect land use with prevalence of overweight and obesity. Their national study employed sprawl indexes as independent variables against outcome variables, such as BMI, obesity, minutes walked, and hypertension. Significant associations were found between all four dependent variables mentioned and a county sprawl index, while at the metro level, only minutes walked was significantly associated. On average, inhabitants of dense counties weighed less and had a lower BMI than their counterparts residing in sprawling counties. A study of 10,878 Atlanta area residents, published in 2004, by Frank et al. (2004) discovered that the likelihood of obesity

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increased by 6% for each additional hour spent in a car per day; obesity likelihood decreased by 4.8% with each additional kilometer walked per day; and for every quartile increase in land-use mix, likelihood of obesity fell by 12.2%. Saelens et al. (2003a) generated similar results when they compared two San Diego communities, one defined as a "high-walkability neighborhood," the other a "low-walkability neighborhood." On average, those residing in the low-walkability neighborhood had a higher BMI than that of high-walkability residents, but this comparison stopped short of statistical significance ($p = .051$). The current study makes a unique contribution to the existing literature by testing the robustness of this relationship within the context of a high-density city. To date, studies assessing the BMI of those living in urban places with a high average density and intense mixing of land uses are lacking.

The present research aimed to look at BMI, auto use, and the physical environment within a dense city, San Francisco. The City and County of San Francisco ranks second to New York, NY, in terms of compactness, and residents there are expected to weigh at least three pounds less than those living in the sprawling, low-density extreme of Geauga County, Ohio (McCann and Ewing, 2003). Despite its reputation for walkable, high-density neighborhoods, San Francisco communities range from high to low on a continuum of density as well as auto use. Granted, low-density neighborhoods by San Francisco standards could quite possibly be considered high-density in many suburbs, but if the relationship is robust, then even within such a city a positive relationship would be expected between BMI and auto use. Simply put, do the supposed health benefits of higher densities and lower auto use level off at extreme densities? Our analysis seeks to take a first look.

## Methods

The research design in this study was cross-sectional. Cluster analysis identified four strata of census tracts with similar population densities, racial makeup, and median household incomes in order to procure a sample ($n = 670$) of San Francisco residents at various public places throughout the city during the summer of 2005. One-hundred and seventy-one of the 176 census tracts contained in the City and County of San Francisco were included in the analysis. Five tracts (176.02, 602, 603, 605.01, and 609) were removed due to a low number of total persons and missing data in the 2000 US Census. Subsets of census tracts were randomly selected from each cluster in equal proportion to the whole. For example, cluster number 3 accounted for approximately 50% of the 171 total census tracts; therefore, 50% of the census tracts included in our four subsets came from that cluster. In total, 60 census tracts were included in our four subsets. We settled on including 60 tracts in our sample due to the number of days available, and the amount of resources allocated for data collection.

Each of the 60 census tracts were then randomly assigned to one of three time frames (7 a.m.–Noon, Noon–5 p.m., and 5 p.m.–10 p.m.) on one of 30 days, excluding weekends, between the months of June and early August 2005. Two tracts were sampled each day. Once every tract was matched with both a time frame and a day, the schedule was reassessed and minor changes were made due to travel issues, safety concerns, and the availability of survey sites within a tract. Several tracts in the sample are almost wholly residential, therefore the nearest tract with a concentration of commercial activity (i.e., commercial street, major supermarket, etc.) was chosen to replace those that are commercially sparse.

On each day that surveys were to be administered, a number between 1 and 10 was randomly selected to serve as that day's skip interval. Potential respondents were solicited at a variety of public places, including parks, busy commercial streets and corners, large grocery stores (chains and local), and cafés (chains and local).

Our sampling method's primary limitation is that it is not wholly random. Lack of resources prevented us from employing a mail or phone survey. Going door-to-door to randomly selected households was considered, but this approach would have excluded those in multi-unit apartment buildings and residential towers, a considerable portion of San Francisco's population (according to the 2000 US Census, 11% of owner-occupied structures and 61.4% of renter-occupied structures contain 5 or more units), due to obvious barriers to access. Of course, our choice of soliciting every __ th person encountered at public places excludes an unknown segment of the population that does not frequent the chosen sites. In weighing the two limitations, we decided we could better live with the latter. The results of this study should be interpreted