



The relationship between height and neighborhood context across racial/ethnic groups: A multi-level analysis of the 1999–2004 U.S. National Health and Nutrition Examination Survey

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ABSTRACT

While a growing literature has documented a link between neighborhood context and health outcomes, little is known about the relationship between neighborhood characteristics and height. Using individual data from the 1999–2004 U.S. National Health and Nutrition Examination Survey merged with tract-level data from the U.S. Census, we investigate several neighborhood characteristics, including neighborhood socioeconomic status (NSES), education index of concentration at the extremes (ICE), and population density, as potential predictors of height. Employing a series of two-level random intercept models, we find a one standard deviation increase in NSES to be associated with a 0.6–1.4 cm height advantage for white and foreign-born Mexican-American females and for U.S. born Mexican-American males, net of individual-level controls. Similarly, a 10 point increase in neighborhood education ICE was associated with 0.23–0.32 cm greater height for white and foreign-born Mexican-American females and U.S. born Mexican-American males. Population density was nominally negatively associated with height for foreign-born Mexican-American females. Our findings reveal that lower physical stature for some ethnic and gender groups is clustered within neighborhoods of low SES and education, suggesting that contextual factors may play a role in influencing height above individual-level attributes.

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1. Introduction

Correlated with a number of health outcomes over the life course, height is a useful marker for health, with the average population height generally increasing during times of prosperity and contracting during times of economic adversity (Batty et al., 2009; Davey Smith et al., 2000). While height is primarily determined by genetics at the individual level, this influence tends to be

unimportant at the population level as long as the racial/ethnic (henceforth ethnic) composition of the population examined is accounted for (Fogel, 1994; McEvoy and Visscher, 2009; Tanner, 1986). Accordingly, differences in height across populations reflect differences in health and longevity.

Studies from industrialized countries suggest that there has been an overall increase in height over time, resulting from gradual changes in environmental conditions (Komlos and Lauderdale, 2007b). These changes include factors that had previously blocked full expression of biological potential, such as infectious diseases, inadequate nutrition, poverty (Tanner, 1992), and food availability and access

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(Floud, 1994; Sunder and Woitek, 2005; Woitek, 2003; Komlos, 1988) sustained during the periods of biological growth (Batty et al., 2009; Finch and Beck, 2011; Peck and Lundberg, 1995; Silventoinen et al., 1999; Singh-Manoux et al., 2010).

Yet, the attainment of biological well-being of Americans, as measured by height, lags behind other economically advanced countries despite the U.S. being among the richest nations in the world (Fredriks et al., 2000; Komlos, 2010; Sunder, 2003). Given the U.S.' relative affluence and economic prosperity, the incongruity between the strong positive association between socioeconomic status and height and Americans' shorter stature compared to citizens of other developed countries is striking.

In developed societies where caloric and protein intake is rarely limited by income, height reflects less the economic output of a community and more of its political, social choices, and lifestyles that influence overall health during childhood development. For example, this has been explored in the context of nutritional intake and obesity (Do et al., 2007; Salois, 2012). Consequently, social and structural factors, including neighborhood context, may contribute to the height attainment of individuals.

Growing evidence indicates a connection between the social and physical environments and individual health, independent of individual-level socioeconomic conditions (Kawachi and Berkman, 2003; Pickett and Pearl, 2001; Robert, 1999; Yen and Syme, 1999). Accordingly, uneven spatial distribution of goods and services, which is much greater in the U.S. than in Europe, may play a role in the relative height disadvantage of Americans (Komlos and Baur, 2004). Hence, a multi-level perspective may provide more insights into the sources of differences in height.

With few exceptions, investigation into how neighborhoods may influence height is virtually non-existent (Komlos and Lauderdale, 2007a; Yoo, 2012). Komlos and Lauderdale's study (2007a) is one of the few that examined the relationship between neighborhood (Zip Code Tabulation Area) conditions and height. After adjusting for individual income and education, little evidence was found to support an association between local economic conditions, as measured by median income, unemployment rate, and poverty rate, and height for either men or women. However, their study relied on a convenience sample of white individuals collected from shopping centers and business areas in the U.S. Hence, more investigations into the possible relationships between neighborhood context and height are warranted before any conclusive inferences can be drawn.

We investigate potential linkages between neighborhood context, specifically neighborhood SES (NSES), educational index concentration of extremes (ICE), and population density level, and whether these contextual factors are associated with height.

2. Neighborhood socioeconomic status, health, and height

Neighborhood socioeconomic level (e.g., poverty, disadvantage index) is commonly used as a measure to capture aspects of the social and structural environment

not routinely measured in survey research. In particular, the socioeconomic characteristics of a neighborhood, also referred to as neighborhood SES, could influence diet through the quantity and quality of supermarkets and restaurants in the area, which, in turn, may determine access to nutritious foods; the availability and affordability of fresh produce; and the ease of transportation to grocery stores or healthy food options (Block et al., 2004; Diez-Roux et al., 1999; French et al., 2001; Macintyre, 2007; Moore and Diez Roux, 2006; Morland et al., 2002; Shohaimi et al., 2004).

Since stature is a good proxy for nutritional attainment among children and youths, access to fruits and vegetables that contribute to a healthy diet may not only be associated with positive health outcomes throughout the life-course but also may influence attained height. Thus, residents of poor neighborhoods may face obstacles to engage in a healthy diet, potentially incurring a permanent deficit in early life nutrition that may arrest the full development of their stature.

2.1. Urbanity, health, and height

Theory is ambiguous on the direction of the relationship between urbanity and health. On the one hand, more rural and less densely populated areas may benefit from lower environmental pollution, slower transmission of contagious diseases, and lower levels of stressors usually associated with city-life. On the other hand, more rural areas are characterized by poorer, less educated populations and fewer resources, including less access to health-care facilities.

While urban areas may have positive aspects such as decreased travel burden to health services compared to non-urban areas (Probst et al., 2007), conditions in urban areas have been called to question concerning its affects on the healthy development of individuals and communities. The health disadvantage of U.S. urban residents relative to non-urban residents has been described as the "urban health penalty" (Greenberg, 1991). Compared to non-urban areas, cities tend to have higher particulate pollution, higher income inequality, more hazardous waste landfills, and higher levels of noise pollution (Galea et al., 2005); all of these characteristics have been linked to a number of adverse health outcomes (Blakely et al., 2002; Passchier-Vermeer and Passchier, 2000; Shima et al., 2002; Vrijheid, 2000).

Poorer living conditions and higher exposure to communicable diseases in more densely populated areas were sources for the height disadvantage of urban residents in the early-industrial period compared to their rural counterparts (Margo and Steckel, 1982; Steckel, 1995). Recent empirical evidence suggests that attributes associated with low population density may still be relevant to height. Komlos and Lauderdale (2007a) found among white men that an increase in population density by a factor of 10 corresponded to a height decrease of 1.4 cm, independent of individual income and education. While the direction of the relationship was the same, no significant association was found for white women.

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