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The association between contextual socioeconomic factors and prevalent asthma in a cohort of Southern California school children

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Abstract

Spatial variation in childhood asthma and a recent increase in prevalence indicate that environmental factors play a significant role in the etiology of this important disease. Socioeconomic position (SEP) has been associated inversely and positively with childhood asthma. These contradictory results indicate a need for systematic research about SEP and asthma. Pathways have been suggested for effects of SEP on asthma at both the individual and community level. We examined the relationship of prevalent asthma to community-level indicators of SEP among 5762 children in 12 Southern California communities, using a multilevel random effects model. Estimates of community-level SEP were derived by summarizing census block group-level data using a novel method of weighting by the proportion of the block groups included in a community-specific bounding rectangle that contained 95% of local study subjects. Community characteristics included measures of male unemployment, household income, low education (i.e., no high school diploma) and poverty. There was a consistent inverse association between male unemployment and asthma across the inter-quartile range of community unemployment rates, indicating that asthma rates increase as community SEP increases. The results were robust to individual-level confounding, methods for summarizing census block group data to the community level, scale of analysis (i.e., community-level vs. neighborhood-level) and the modeling algorithm. The positive association between SEP and prevalent childhood asthma might be explained by differential access to medical care that remains unmeasured, by the hygiene hypothesis (e.g., lower SES may associate with higher protective exposures to endotoxin in early life), or by SEP acting as a proxy for unmeasured neighborhood characteristics.
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Introduction

Childhood asthma is now the leading chronic disease of children amongst industrialized countries (Centers for Disease Control and Prevention, 2003). In the United States, prevalent asthma rose from

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3.4% to 5.5% between 1980 and 1996 in children 0–14 years of age, and in some communities the prevalence exceeds 20% (Mannino et al., 2002). The increase in prevalence, as well as large variation in prevalence between settings, within the US and globally, has yet to be fully explained (Basagana et al. 2004; Beasley, Ellwood, & Asher, 2003; Cagney & Browning, 2004; Federico & Liu, 2003; Juhn et al. 2005; Pearce, Douwes, & Beasley, 2000; Pearce, Pekkanen, & Beasley, 1999; Redd, 2002). Similarly, the etiology of childhood asthma remains unclear. Current research is focused on both genetic and environmental factors. While genetic factors may predispose a child to asthma, geographical heterogeneity along with the rise in prevalence indicate that environmental factors probably contribute to the pathogenesis of asthma. There is a large literature examining associations of asthma with an individual's housing characteristics, including home dampness, indoor allergens, environmental tobacco smoke, dietary factors and social position (Billings & Howard, 1998; Gold & Wright, 2005; Mielck, Reitmeir, & Wjst, 1996). Although findings remain mixed, collectively the studies suggest an effect of the built and social environment on asthma onset and severity.

Lower socioeconomic position (SEP) has been associated with severity of asthma in children and is linked with racial/ethnic disparities in the US (Gold & Wright, 2005; Mielck et al., 1996), although the reasons for this relationship are not well understood. Lower SEP may act as a proxy for causal environmental effects, such as elevated air pollution exposure (O'Neill et al., 2003) and poor housing conditions (Shapiro & Stout, 2002). Theoretically, geographic variation in asthma may be broken down into pathways operating at the individual level (i.e., "compositional" effects) and at the community or neighborhood level (i.e., "contextual" effects) (Diez Roux, 2002). Although compositional effects can be adequately controlled with individual-level variables, contextual effects imply independent or interactive contributions to health from the social and environmental place in which an individual lives or works (e.g., neighborhood crime that might result in increased stress and other behaviors not well measured by readily available individual-level variables). Research on the impact of the social environment on childhood asthma has traditionally focused on individual-level exposures, for example, socioeconomic position of the family (King, Mannino, & Holguin, 2004; Mielck et al., 1996; Ortega et al., 2001; Pearce, Beasley, Burgess, & Crane, 1998; Wright, 2004); however, research about these compositional effects has not completely explained the differences in asthma between communities. Potential contextual effects on asthma have been proposed (Gold & Wright, 2005), indicating the need for a multilevel approach to studies of childhood asthma epidemiology (Merlo, Chaix, Yang, Lynch, & Rastam, 2005). Multilevel models have only rarely been used to explore how the socioeconomic environment can impact asthma (Basaganaet al., 2004; Cagney & Browning, 2004), and few studies have focused specifically on childhood asthma (Juhn et al., 2005; Nepomnyaschy & Reichman, 2006). The purpose of this paper is to analyze the relationship between community socioeconomic characteristics and asthma among school children in Southern California using a multilevel model.

Methods

Study design and subjects

The Children's Health Study (CHS) is a study of the long-term effects of air pollution and other risk factors on the respiratory health of children. The study originally comprised 12 Southern California communities with 5762 participants (79% participation rate) (McConnell, Berhane, Gilliland, London et al., 2002) (see Fig. 1 for map of community and respondent locations). Children in the 4th, 7th and 10th grades were recruited in 1993 and 1996 and followed through high school graduation. Associations of asthma with housing characteristics, obesity, air pollution, family history and exercise have been previously described (Gaudermanet al., 2005; Gilliland et al., 2003; Kunzli et al., 2003; London, James Gauderman, Avol, Rappaport, & Peters, 2001; McConnell, Berhane, Gilliland, Islam,et al., 2002; McConnell, Berhane, Gilliland London, et al., 2002; McConnell et al., 2006). A detailed description of the selection of communities, subject recruitment and survey methods to assess demographic, household, activity and baseline medical characteristics has also been reported (Peters et al., 1999). The current analysis is the first examination of the contextual effects of SEP on asthma in the CHS.

Written informed consent was obtained from a parent or legal guardian for all study subjects. The University of Southern California's institutional review board approved the study protocol.

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