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Original article

Role of individual-housing–based socioeconomic status measure in relation to smoking status among late adolescents with asthma

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ABSTRACT

Purpose: We aimed to assess whether smoking status among individuals in late adolescence (19–22 years) with asthma was associated with socioeconomic status (SES) defined by HOUSES, an individual-housing–based SES measure.

Methods: A population-based cross-sectional study was conducted among the 1988–1989 Olmsted County, Minnesota Birth Cohort, with physician-diagnosed asthma and that lived in the community during the study period (November 1, 2008–October 31, 2012). Using a z score for housing value, actual square footage, and numbers of bedrooms and bathrooms, HOUSES was formulated and categorized into quartiles. Smoking status (both current and past smoker) was compared among subjects with different SES as measured by HOUSES using logistic regression, adjusting for age and sex.

Results: Among 289 eligible subjects, 287 (99%) were successfully geo-coded to real property data for HOUSES. Of the 257 subjects whose smoke exposure was recorded, 70 (27%) had a history of smoking (either past or current). An inverse association was observed between HOUSES and smoking status after accounting for age, gender, and General Medical Examination status (adjusted OR = 0.39, 95% CI = 0.18–0.87 for comparing highest vs. lowest HOUSES in quartile; overall $P = .02$).

Conclusions: A significant proportion of individuals with asthma in late adolescence was smokers during the study period, disproportionally affecting those with lower SES.

Introduction

Asthma is the most common chronic illness in childhood and a major cause of morbidity in adults. Although a recent report showed overall childhood asthma prevalence increased from 2001 to 2009 followed by a plateau then a decline in 2013, this pattern varies with age, region, race, and socioeconomic status (SES) [1]. Identifying factors associated with persistence of childhood asthma into adulthood is important for patients, their families, and health care providers, and some factors related to asthma remission have been suggested [2–4]. Tai et al. in his longitudinal prospective study up to age of 50 years reported that asthma remission occurred most commonly between the age 14 and 21 years [5]. The late adolescence (age, 19–22 years), as a transitioning time from childhood to adulthood may be important in terms of asthma remission and risk of new onset of asthma (i.e., adulthood asthma) by controlling modifiable risk factors such as smoking [5,6].

Smoking has been a well-known risk factor for asthma development and asthma outcomes [6–15]. Unfortunately, adolescents with asthma have higher or similar smoking prevalence than those without asthma [16–20]. Although one might expect adolescents with asthma to quit smoking earlier than those without asthma, literature suggests that adolescents and adults with asthma were significantly less likely to quit smoking than their peers without

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asthma [21,22]. Furthermore, cigarette smoking is more prevalent among those with low SES and quit attempts are less likely to be successful compared to those with higher SES [23]. However, little is known about whether SES is associated with smoking rate among late adolescents with asthma.

Despite the potential relationship of SES to smoking rate among those with asthma, socioeconomic data are often unavailable in data sets used in clinical research, such as administrative data and medical records [24–26]. The neighborhood SESs (e.g., Census data) are often used as a proxy of individual SES, but literature has found that the use of area-based proxies for individual-level measures resulted in overestimates or underestimates of socioeconomic gradients in health [27–31]. Also, it has been reported that individual-level socioeconomic measures are more strongly associated with smoking history than area-level measures among late adolescents [32].

Our research team recently developed individual-level housing-based socioeconomic status measure (termed HOUSES) based on real property data, and reported HOUSES predicts health outcomes (e.g., asthma exacerbation) as well as risk factors for health outcomes (e.g., smoking exposure at home) [33–39]. As SES is associated with risk of asthma (although the result in the literature is inconsistent) [40–44], it is important to further investigate the association of SES with smoking rate among late adolescents with asthma. We hypothesized SES as measured by HOUSES is associated with history of smoking among late adolescents with asthma.

Material and methods

Study setting

The study was approved by the institutional review boards at both Mayo Clinic and Olmsted County Medical Center. Health care in Olmsted County, Minnesota, is virtually self-contained within the community. When patients register with any health care provider in the community, they are asked whether they authorize use of their medical records for research. If one grants the authorization (95%) for using medical record for research, each patient is assigned a unique identifier under the auspices of the Rochester Epidemiology Project (REP) [45–49], which has been continuously funded by the NIH since 1960. All clinical diagnoses and information from every episode of care are contained within detailed patient-based medical records. This unique longitudinal population-based resource has been the source of over 2000 publications [50]. During the study period, characteristics of the City of Rochester and Olmsted County populations were similar to those of the U.S. Caucasian population, with the exception of a higher proportion of the working population employed in the health care industry [51–53]. Using REP resources, we previously demonstrated that incidence rates of asthma for this community are similar to other communities [54].

Study design and subjects

This present study used a previous unpublished population-based cross-sectional study which was designed for assessing the H1N1 and the Pneumococcal Polysaccharide Vaccine 23 valent (PPV23) vaccine uptake rate among individuals with asthma and conducted among the Olmsted County Birth Cohort born between January 1, 1988–September 30, 1989 that lived in the community during the study period (November 1, 2008–October 31, 2012) with asthma ever (n = 371). Individuals who did not grant authorization for using medical records for research or non-Olmsted County, MN, resident as of October 1, 2009 were excluded (n = 89). In this present study, we assessed the association of SES measured by HOUSES with smoking rate among late adolescents with asthma using the original study data. Asthma status was defined by physician-diagnosed asthma by *International classification of Diseases, Ninth Revision* (ICD-9) code (493). Active asthma status (vs. inactive) was defined by any asthma-related symptom, medication, or medical visits documented during the past 12 months.

Smoking status

We comprehensively reviewed individual's medical records to ascertain tobacco smoking status for within 6 months before the time of chart review (i.e., past smoker, current smoker, passive smoker, nonsmoker, and unknown). We then grouped individuals with regard to history of tobacco smoke exposure; past or current smoker (i.e., smoker) versus passive or nonsmoker (i.e., nonsmoker) as we were interested in smoking behavior among late adolescents with asthma rather than biological effects of smoking.

Socioeconomic status

To determine if socioeconomic status (SES) is associated with smoke exposure, we used the REP Database and a SES index derived from housing characteristics (HOUSES). HOUSES was developed for health disparities research using retrospective data sets and real property data [33,34]. Address-linked real property data were obtained from the Assessor's Office and matched to the subject's address in the medical record. Real property data sets are maintained by the Assessor's Office of the Olmsted County government for the purposes of property taxation and publicly available. Information from these data sets was used to formulate the HOUSES index which includes: (1) ownership status, (2) lot size of the housing unit, (3) square footage of the housing unit, (4) residential status (whether a housing unit is in a residential zoning), (5) number of bathrooms, (6) number of bedrooms, (7) building value (assessor's estimate), and (8) neighborhood SES (Census block-group level). Based on the principal component factor analysis, we formulated a standardized HOUSES index score by summing all variables of each factor (i.e., housing value, actual square footage, and numbers of bedrooms and bathrooms) after transforming variables to z scores, and the z score is then categorized into quartiles. The reason why we chose quartiles in this study was to keep the consistency with our previous report and to allow us to measure a dose-response relationship between exposure (i.e., HOUSES) and outcome (i.e., smoking status). Higher HOUSES is associated with greater SES. HOUSES correlates with several health risks, such as tobacco smoke exposure at home among children and adolescents [34].

Other variables

We collected from medical records other relevant variables such as occupational status (student vs. employment as of October 1, 2009), educational attainment (high school graduate or less vs. some college or greater), vaccination status (Human Papillomavirus [HPV], seasonal influenza, PPV23), and presence of general medical examination (GME) visit during study period to assess the association with smoking rate.

Statistical analysis

Each variable was assessed for the association with smoking status (smoker vs. nonsmoker), using logistic regression models, and odds ratios (OR) and their corresponding 95% confidence intervals (95% CIs) were presented. SES measured by HOUSES was