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Built environment factors contribute to asthma morbidity in older people: A case study of Seoul, Korea☆

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ABSTRACT

This paper aims to examine various built environment factors contributing to asthma and severe asthma morbidities in older people by performing spatial regression analysis. By controlling the socio-demographic factors of asthma in Seoul, we found a significant correlation of the built environment factors with severe asthma rather than with asthma in older people. The results suggest that population density and bus transit can make asthma severe in older people, while active transportation activities have a positive influence on severe asthma in older people. However, a significant contribution of built environment factors to asthma in older people is not identified. The findings from spatial regression imply that the collaboration of multi-level governments and agencies needs to develop policies for mitigating poor air quality from the perspective of environmental justice.

1. Introduction

Asthma is a highly prevalent health problem with a significant global impact. According to the recent comprehensive analyses of the Global Burden of Disease Study performed during 2008–2010, the number of people with asthma is approximately 334 million. The burden of asthma, measured by disability and premature death, is higher in children approaching adolescence (between 10 and 14 years of age) and in the elderly (between 75 and 79 years of age; Global Asthma Network, 2014). The estimated direct and indirect monetary costs for asthma totaled $12.7 billion in 1998 in the United States (Weiss et al., 2000). Although the causes of asthma remain inconclusive, considerable medical and clinical research has been conducted to identify the risk factors of asthma morbidity due to various causes such as smoking habits, molds, allergens, heating fuels, and house dusts (Mishra, 2003; Rogers et al., 2002; Huss et al., 2015; Howden-Chapman et al., 2008; von Mutius, 2002).

Although research on asthma is conventionally performed by researchers in the medical field, morbidity due to asthma has attracted the attention of scholars and professionals in public health because of its clear relationship with socio-demographic factors. Considerable research suggests that one of the most dominant risk factors of asthma is patients' socio-demographic characteristics. These characteristics include poverty, age, and ethnicity (Weiss et al., 1992; Miller 2000; Wissow et al., 1998; Haselkorn et al., 2008; Wright and Subramanian, 2007; Bryant-Stephens, 2009). This suggests that asthma is a significant health problem for under-represented populations. Studies have confirmed that asthma that occurs in older age often has similar clinical and physiological consequences to that in younger patients (Hanania et al., 2011), and considerable research recognizes especially children and older people as the most vulnerable population cohorts for asthma (Wissow et al., 1998; McConnell et al., 2006; Lin et al., 2002; Oftedal

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et al., 2009; King and Hanania, 2010; Simoni et al., 2015).

Given the recent aging of society that the growth in the number and proportion of senior population is unprecedented, asthma in older people has become an even more important issue. There might be an increasing number of potential asthma victims in the rapidly aging society. Moreover, both longer life spans and aging baby boomers will together double the population of Americans aged 65 and older in the next 25 years. By 2030, there will be 71 million American older adults who account for roughly 20% of the U.S. population (National Academy on an Aging Society, 2007). This trend of an aging society is also commonly found in Asian countries such as Korea and Japan.

In general, the health of senior population in an aging society has become a serious social issue. Currently, about 80% of older Americans are experiencing at least one chronic condition. The cost of providing health care for an older American is three to five times higher than that for someone younger than 65 years. As a result, by 2030, the nation's health care spending is projected to increase by 25% (National Academy on an Aging Society, 2007). Apparently, asthma in older people has become one of the diseases that contributes to health care burdens on the society in the future.

One of the well-known environmental factors contributing to asthma is ambient air pollution. Extended research has associated air pollutants with the epidemiology of asthma. They include particulate matter (PM), ozone, and diesel exhaust (Gielen et al., 1997; égala et al., 1998; Studnicka et al., 1997; Peden, 2005; Corburn et al., 2006; Bryant-Stephens, 2009, Kawachi and Berkman 2003). The relationship between ambient air quality and asthma morbidity in older people is especially important because exposure to air pollutants may even be fatal to older people because of comorbidities (Simoni et al., 2015). With the combination of trends of aging society and global warming, asthma induced by air pollution in older people will become increasingly severe.

Although it is clear that the urban built environment has become the major source of the high level of air pollution, there is only limited research that addresses the indirect influence of built environment factors on asthma morbidity in older people. While the clear cause and effect relationship between air pollution and asthma morbidity are well established, there has been less attention to the factors present in urban environment, which generates air pollution and consequently influences asthma morbidity. Assuming that older people manage to have relatively fewer outdoor activities than other population cohorts, considerable research has found asthma risk factors such as indoor air quality associated with allergens and house dusts and behavioral aspects including smoking habits in older people (Mishra, 2003; Rogers et al., 2002; Huss et al., 2015). Although some research has identified traffic-related exposure as a contributing factor to asthma in older people (Smargiassi et al., 2006), there is only limited research that adequately analyzes the relationship between the quality of urban environment and asthma morbidity in older people.

In sum, there are several research gaps in the literature. First, previous studies mostly quantified the role of environment in the prevalence of asthma in senior people, and the studies focused more on the influence of roadway characteristics. Second, although there are different types of asthma morbidity such as asthma and severe asthma, only little is known about the influence of built environment on severe asthma. The comparison between asthma and severe asthma in terms of environmental roles remains unanswered. Third, in aggregating spatial variables, earlier works were mostly based on the hospital location rather than on the residential location of patients.

The purpose of this paper is to examine the built environment factors that contribute to asthma morbidity in older people. Hypothesizing that built environment contaminates ambient air by emitting harmful pollutants and the contaminated air contributes to asthma in older people, this paper pays attention to the indirect influence of built environment on asthma morbidity in older people rather than to the cause and effect of air pollution on asthma in senior citizens. This paper sheds light on the relationship between a variety of land use and transportation factors and asthma morbidity in older people in the Seoul, Korea. While controlling socio-demographic factors, this paper attempts to focus on the influence of built environment factors on asthma morbidity in older people by performing a series of spatial regression analyses. This paper also investigates the influence of built environment on the different statuses of asthma in older people. By the combined use of insurance claim data and doctors' asthma diagnosis, this paper identifies the status of asthma patients and classifies them into two types of asthma morbidity, asthma and severe asthma. This paper also examines the influence of built environment factors on the status of the two types of asthma.

2. Study context

This study was conducted in Seoul, which is the capital city of South Korea. With a population of 10,297,138, Seoul was ranked as the 14th largest city in the world in 2015. Seoul provides the ideal attributes for this paper in several regards. Asthma patient data from Seoul are an important source for this paper. Because of the public health insurance system of the Korean national government, doctors in Korea are required to submit their insurance claims to a centralized governmental agency named the National Health Insurance Service (NHIS). An insurance claim is issued for every patient's visit. This consists of detailed information ranging from the patients' personal information to the doctors' diagnosis. This paper determined the number of asthma patients, classified the asthma patients' status, and identified their residence location using the insurance claim data. Although the NHIS stores data on patients' home address, it could not acquire the data on privacy issues. Instead, the data that aggregated the locations of the patients into "Dong" level were collected for this study.

The city's ethnically homogenous population helped this study in controlling the influence of ethnicity on asthma in older people. As mentioned in previous research, ethnicity is one of the significant demographic factors that influence asthma morbidity (Miller 2000; Wissow et al., 1998). However, ethnic variations are not an important factor in the case of Seoul. In 2015, 74,629 people (equivalent to 0.7% of the total population) were identified as belonging to different ethnic groups other than Korean. The dominant Korean population in Seoul minimizes the effects of ethnicity on asthma morbidity in older people.

The city's dense, intense built environment also supports this study. The city has an area of 234.4 square miles and consists of a