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Inequality of Asian-type neighborhood environmental quality in communities with different urbanization levels☆

Shih-Chun Candice Lung [a,b,*], Chung-Rui Lee [a], Shu-Chuan Hu [a]

[a] Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan
[b] Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan

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ABSTRACT

Inequality of neighborhood environmental quality (NEQ) is an important pathway through which social inequality results in health disparity. It is critical to assess NEQ which is related to the urbanization level (UL) of the residents' domiciles and socio-economic status (SES). This study evaluates the major determinants and inequality of Asian-type NEQ, considering both UL and SES. Data from a representative country-wide survey in Taiwan were adopted to assess the chemical, disturbance, and social aspects of NEQ, with 1.906 subjects aged 18 years or above from 88 communities. The results showed that 30% and 24% of subjects living within 15 m from busy roads and smoky/greasy restaurants, respectively, demonstrating widespread traffic pollution and spot pollution sources within communities. ULs of communities, education, age, and SES are statistically significant determinants of various NEQ indicators. More importantly, NEQ inequality does exist and shows opposite patterns across different spatial scales, revealing spatial heterogeneity. Subjects in communities of higher ULs, consisted of larger percentages of residents with better SES, have higher odds of chemical exposure (2.2–21.2), disturbance (3.5–4.3), and social stress (1.9–4.3) than those in rural communities. On the other hand, within communities of the same ULs, subjects of poorer SES have higher odds of pollution exposure (2.6–2.7) and social stress (4.8). Furthermore, this work demonstrates an objective assessment of NEQ with survey methods which can be applied to assess important neighborhood environmental issues in all countries. Spatial heterogeneity of environmental inequality is identified by this study for the first time. It may be a common phenomenon shared by other countries; it has significant implications for environmental health policies and studies.

1. Introduction

"Environmental inequality" is one of the potential pathways through which social inequality results in health disparity (Deguen and Zmirou-Navier, 2010; O'Neill et al., 2003). For example, exposure to air pollution is associated with acute and chronic health problems, such as respiratory and cardiovascular diseases (e.g., U.S. EPA, 2009). Previous research in western countries such as the U.S., New Zealand,

* *Corresponding author at*: Research Center for Environmental Changes, Academia Sinica, No. 128, Section 2, Academia Road, Nangang, Taipei 11529, Taiwan. Tel.: +886 2 26539885x277; fax: +886 2 27833584.
E-mail address: sclung@rcec.sinica.edu.tw (S.-C. Lung).

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and European nations suggested that socially disadvantaged groups are exposed to higher levels of pollution in residences (e.g., Braubach and Fairburn, 2010; Stevenson et al., 2009). A number of studies have further demonstrated that intra-community indicators of local air quality of residences are associated with adverse health outcomes (e.g., McConnell et al., 2010). Thus, to evaluate the major determinants of neighborhood environmental quality (NEQ) and to examine the existence of inequality of NEQ are essential steps toward formulating effective environmental control strategies.

NEQ is closely related to the characteristics of the built environment of residences. In reality, the choice of residential neighborhood depends on a lot of factors, especially socio-economic ones, such as financial ability (Popenoe and Michelson, 2002). For example, the average house price in Taipei, the capital of Taiwan, is four times that of those in the vicinities (CPAMI Taiwan, 2011), demonstrating significant impact of financial ability on the choice of residences in Taiwan. Urbanization level (UL) of the community is an indicator of area-level socio-economic status (SES) of the residents with high SES groups enjoying better accessibility to urban service and resources (O'Neill et al., 2003). Additionally, communities of different ULs have different NEQ features (Popenoe and Michelson, 2002). In urban areas, high energy usage, heavy traffic, and mass consumption have resulted in alarming levels of air pollution. In the US, wealthy and middle-class people have moved out of the inner-city areas, which then become government-subsidized construction projects for populations of lower SES. However, it is not the case in Asian countries. The global trend of urbanization has aggravated NEQ deterioration of urban dwellers, particularly those in Asia, where economic growth in the past 30 years has accelerated environment deterioration, and the majority of the population is projected to live in urban areas by 2030 (UN, 2008).

Moreover, the residential neighborhoods in Asian countries have distinctive features compared to the West. Their development can be traced back hundreds of years ago when there was no strict urban planning and the population density remains high up to now. For instance, the population density of Taipei was 9593 /km^2 in 2011 (DGBAS, 2011). Along with increase in urban population came the influx of other facilities into the communities. As a result, the initially pure residential areas became mixed with shops, restaurants, temples, and home manufacturers. These mixed communities house many sources of air pollutants emitted into the immediate living environments, exposing local residents to high variability of pollutant levels within communities. Lung et al. (2007) showed that air quality of Taiwanese urban communities is influenced by the localized pollution sources within communities, which cannot be reflected by the ambient levels at EPA monitoring stations. There has been increasing research in western countries probing into inequalities in pollution exposure and associated health outcomes among groups of different SES (e.g., Briggs et al., 2008; O'Neill et al., 2003). However, similar studies in Asia are scarce with even inconsistent findings. Stern (2003) found that poorer people expose to higher air pollution in Hong Kong; while Sun and Gu (2008) found that a poorer health status is associated with a higher air pollution index, which correlated positively with more well-off cities in China. Therefore, the complex interaction between social class and NEQ in Asia deserves more attention. The current study focuses on exploring such a relationship from an Asian perspective.

Furthermore, health disparities among groups of different SES can be attributed to other community stressors, such as noise and social stresses, besides air pollution (Gee and Payne-Sturges, 2004). Therefore, three different aspects of NEQ, namely, chemical, disturbance, and social aspects, are assessed in this study. Inequality of such neighborhood exposure is also explored and discussed.

On the other hand, differential neighborhood exposure may be directly associated with SES of individuals, such as education and occupation (O'Neill et al., 2003). Thus, SES may influence directly residents' neighborhood exposure or indirectly through the choice of their residences. This study tries to distinguish direct and indirect impacts of SES on differential neighborhood exposure (Fig. 1). While the direct influence of SES on neighborhood exposure can be reduced by health promotion that may take some time to be realized, the impacts of ULs of residences on neighborhood exposure may be alleviated relatively sooner via effective source control and administrative strategies. Therefore, the findings of this work can provide useful references for authorities to formulate environmental control strategies for reducing health disparity due to environmental inequality.

Most research on environmental inequality was about large-scale polluters such as hazardous waste sites and industrial parks (Perlin et al., 1999). In contrast, this study focuses on small-scale polluters in everyday lives of Asian residents. Take Taiwan for example. After 40 years of economic development and 20 years of environmental protection movement, there are laws and regulations on industrial emission control. In recent years, protests from people have been targeted at emissions from restaurants and night markets in their neighborhoods (ETtoday News, 2011), demonstrating the severity of neighborhood pollution. Nevertheless, NEQ assessment is a challenging task. In social science, case study and individual interview have been employed to study neighborhood environmental inequality issues (Stern, 2003). However, lack of quantitative results and representativeness are their limitations. On the other hand, previous environmental inequality studies with quantitative methods applied either ambient monitoring or modeling results for air pollution distribution, which is not suitable for evaluation of NEQ occurring at a local scale (Forastiere et al., 2007; Sun and Gu, 2008). In order to gain a representative overview with quantitative assessment on NEQ, this study employed survey methods to evaluate NEQ in Taiwan, which serves as an example country with Asian characteristics having mixed communities of high population density. Particular attention will be paid to exploring whether NEQ is a problem for most communities and whether inequality of NEQ does exist in Taiwan. In summary, the objective of this study is to assess the major determinants and inequality of NEQ in Taiwan, considering both SES and ULs. The research outcomes have significant implications on pollution control strategies and health promotion not only for Taiwan but also for other Asian countries with similar features.