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Exploring tuberculosis by types of housing development

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ABSTRACT

Tuberculosis (TB) is known as a disease of poverty. It has also been related to poor living environment. This study examines the relationship between TB outcome and housing characteristics which is reflective of the socio-economic standing. We sought to investigate the association from two novel angles: (1) TB outcome against floor level of residence, and (2) TB outcome against types of housing development. A total of 1787 culture-positive TB cases were collected by the Centralized Mycobacterium Laboratory from 2007 to 2009. Most of the cases fell in the catchment area of the Kowloon West Cluster, a densely populated urban area in Hong Kong. The distribution of culture-positive TB cases by floor levels of residence and types of housing was examined by descriptive and non-parametric statistical analyses. The effects of vertical distance of residence from the street level on TB outcome by different types of housing development were further explored by regression methods. Our study confirmed more TB cases among tenants on the lower floors and observed a decreasing trend towards higher floors. It also revealed that significantly more TB cases were residing in public as opposed to private or other types of housing (Chi-square = 151.14, $p < 0.0001$). Regression analysis by different housing types showed significantly different rates of change between floor number and TB cases ($p < 0.0001$). Our findings offer evidence on the inverse associations between floor levels of residence and TB occurrences and showed that the patterns were dependent on housing types. We demonstrated how housing characteristics could be useful input in an ecological study of the TB disease. These results have significant design and health implications for Asian cities that are getting denser and growing taller.

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Introduction

Ever since the SARS epidemic hit Hong Kong in 2003, the spread of infectious respiratory disease in an overcrowded and multi-storey built environment has become an issue of grave concern (Gao, Niu, Perino, & Heiselberg, 2008). Previous research on Tuberculosis (TB) has shown that the quality of living environment is indivisible from socio-economic status (SES) and TB is consistently found among the poorer families (Lopez De Fede, Stewart, Harris, & Mayfield-Smith, 2008; Oren, 2010). Although low household income has been widely used as a deprivation indicator to measure TB prevalence (Chan-yeung et al., 2005; Pang, Leung, & Lee, 2010), other associated housing characteristics such as crowding (Baker, Das, Venugopal, & Howden-Chapman, 2008; Leung et al., 2004; Wanyeki et al., 2006), inadequate ventilation (Beggs, Noakes, Sleigh, Fletcher, & Siddiqi, 2003) and building features (Wanyeki et al., 2006) are considered significant determinants of the disease. These studies not only supported the population health framework which recognises social and economic environment as the principal determinants of health (Dunn & Hayes, 2000), but also further demonstrated housing-health relationship in measuring environmental health impact.

The SES of communities in Hong Kong can be assessed through the type of dwelling in which one lives. The Government of Hong Kong provides affordable housing to lower-income residents through a set of mass housing programmes (viz., home ownership scheme, buy or rent option, mortgage subsidy, sandwich class housing, urban improvement, and flat-for-sale schemes) collectively known as public housing. Rents and prices of public housing are significantly lower than those for private housing as the former is heavily subsidized by the government. Only applicants or tenants that meet the income and net asset limitations (i.e., the so-called needy group) are eligible for public housing (Hong Kong Housing Authority, n.d.). Nearly 46 percent of the population in Hong Kong resides in some forms of public housing (29 percent in rental and 17 percent in subsidized sales flat) while the remaining with

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medium to high household income lives in private permanent flats/houses (Hong Kong Census and Statistic Department, 2012; Hong Kong Housing Authority, 2012). Private permanent housing includes private housing estate characterized with a cluster of high-rise flats with different vertical components such as carparks and amenities (Zhu & Chiu, 2011), single blocks of flats (which vary in designs and heights), landed properties, and tenement houses.

Dwelling/housing which reflects the quality of the living environment has been perceived as an indicator of SES in health studies (Dunn, 2006; Dunn & Hayes, 2000). SES of the population of Hong Kong is markedly reflected through their dwelling types comprising largely of high-rises (Delang & Lung, 2010; Department of Health, 2004) and their sales or rental values (Bucchianeri, 2010). The residential property prices are influenced by structural housing attributes such as housing/estate type (Lau, 2005; Tse & Love, 2000) and storey level (Hui, Zhong, & Yu, 2012; Wong, Chau, Yau, & Cheung, 2011). Besides, neighbouring and environmental characteristic such as air quality (Hui, Chau, Pun, & Law, 2007) and landscape view (Jim & Chen, 2010) also have effects on high-rise residential values. The hedonic pricing model as determined by the structural attributes of a flat shows that housing units at a higher level demand a higher premium because of better environmental quality and better views on higher floors (Hui et al., 2012; Wong et al., 2011). Because of the additional premiums, it is generally accepted in Hong Kong that private housing, higher storey level, and pleasant visual characters (i.e., more openness and presence of greenery) which reflect better quality of living and neighbourhood environments (Lai, 2012) are desirable housing attributes only common among the more affluent groups. On the contrary, public housing is more affordable and forms a major housing component for lower-income residents albeit the housing standards have been widely criticised (Hui, 1999).

Poor living environment (crowding, poor air ventilation within the homes, etc.) which have direct or indirect influences on TB occurrences are frequently encountered alongside indicators of the socially disadvantage. In Hong Kong, population groups residing in neighbourhoods with low household incomes were found more susceptible to TB occurrence (Chan-yeung et al., 2005; Pang et al., 2010). Noting that poor housing conditions are closely related to deprivation, this paper examines the relationships between TB outcome and storey level by housing type. The study intends to demonstrate that housing characteristics can be used as an SES indicator in estimating disease burden of TB under the population health framework. Inspired by the vertical location of a property in the hedonic pricing model, we further postulate that TB outcome by storey level is reflective of the property price gradient in the opposite trend.

Data and methods

Data and study area

Hong Kong is one of the most densely populated places in the world and notorious for its' compact living environment. The shortages of flat lands and high land values have prompted buildings to develop in the vertical direction. This study is a retrospective ecological analysis of housing characteristics of TB positive specimens collected from the Centralized Mycobacterium Laboratory in the Kowloon West Cluster (KWC). The catchment area of the KWC served an estimated population of 1.9 million, representing 27 percent of the overall Hong Kong population in 2009 (Hospital Authority, 2010). A total of 1787 TB positive cases were accumulated from 2007 to 2009 in which 1668 had valid addresses for geocoding. The majority (83.8 percent) of TB cases came from KWC districts (Yau Tsim Mong, Sham Shui Po, Kwai Tsing, Tsuen Wan and Wong Tai Sin) and one non-KWC but contiguous district (Kowloon City), as shown in Fig. 1.

Data about buildings (name, age, type, number of stories, etc.) were purchased from the Census and Statistics Department. These data were used to classify buildings by type and floor level for further analysis. Ethical approval KW/EX/11-034(37-08) has been obtained from the Kowloon West Cluster Research Ethics Committee.

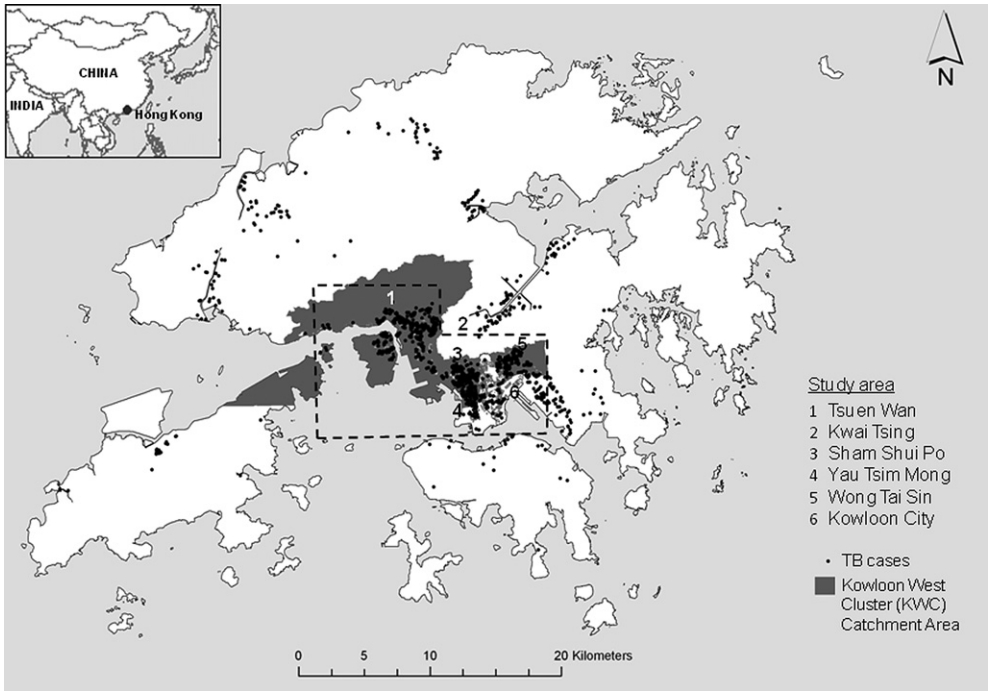

Fig. 1. Spatial distribution of culture-positive tuberculosis cases, 2007–2009.

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