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Original Research

# Pure spatial and space-time clusters of self-harm in Kwai Tsing 2004 to 2012

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## 1. Introduction

The geospatial approach has opened up new ways to understand self-harm distribution and correlation with relevant attributes, which is not just limited to studying spatial epidemiological factors, but also the individual and area characteristics. Recent evidence has shown that the analytical, data linkage, and mapping tools of geographic information systems (GIS) could be used to address social determinants and identify population in need (Bell and Schuurman 2010). Literature also showed that GIS could be applied in the health promotion and public health perspectives, which include themes of disease surveillance, risk analysis, health service access planning, and community health profiling (Nykiforuk and Flaman 2011). Self-harm studies can benefit from exploring the spatial and temporal characteristics to provide information on factors influencing self-harm. Recent GIS studies have identified that proximity to services, population density, and social fragmentation have significant influence on the self-harm incidence, with deprivation being the strongest area-level predictor of self-harm (O'Farrell et al. 2015). GIS has been proven to be useful in such investigations to inform decision-making for targeted prevention of self-harm.

The self-harm rate in Hong Kong (HK) has increased by 24% in the past few years and has hit an historic high of 60.5 per 100,000 population (CSRP, 2009). The highest number of episodes was found in Kwai Tsing area of HK, which recorded more than 2000 episodes during 2004–2008. When comparing the crude rate in 2004 and 2008, the rate of self-harm in Kwai Tsing was top in 2004 and the fourth in 2008. For the standardized ratios at different age bands, Kwai Tsing also ranked top in all age bands, except for the 25–34 age group where it was ranked second highest among the 18 administrative districts in HK. In 2008, Kwai Tsing was in the top three areas with high standardized ratios of self-harm. Kwai Tsing is recognized as an area with high risk of self-harm among the 18 administrative districts in HK. We selected this district in HK as the study area in our spatial epidemiological study.

To the best of our knowledge, this is the first spatial epidemiological study on self-harm in Kwai Tsing. Kwai Ts-

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ing is a small district in HK with 58 large street blocks (LSB; $n = 58$). The study objectives were (i) to identify the spatial and space-time clusters of self-harm in Kwai Tsing; and (ii) to identify the characteristics of these cases within and outside the clusters.

## 2. Methodology

### 2.1. Study design

This was a spatial epidemiological study of self-harm in 58 LSBs of Kwai Tsing from January 2004 to December 2012. All included cases were retrieved from the hospital records by self-harm codes and geocoded to residential addresses in Kwai Tsing. This research was approved by the Kowloon West Cluster Ethics Committee of the Hospital Authority (HA) in HK.

### 2.2. Data

The HA information system has two databases that can record identified self-harm cases. Cases can be retrieved by self-harm codes from the Accident and Emergency (A&E) department database and by diagnosis codes from the hospital inpatient electronic database. For A&E records, self-harm identifiers were used to record the type of injury or type of self-poisoning, which were not mutually exclusive and depended on the self-harm method. For inpatient records, the identifiers were the diagnostic codes assigned by the attending physician upon discharge of patient from the hospital. The inpatient diagnosis codes followed the International Classification of Disease (ICD 9 CM) rules and structures. Within the ICD 9 CM, the self-harm codes were classified by external cause of injury (E codes), which range from E950-958, 300.9 and 977.9. For the case identification, a patient reference key was assigned as a unique identifier for each patient in the HA records. The data set included the patient demographics, diagnosis and outcomes. Incidence and episodes of self-harm were identified from the of A&E and inpatient records for analysis in our study.

In Hong Kong, majority of the self-harm would be transferred by ambulance and then treated in the public hospitals under the Hospital Authority. On the other hand, it would also be expensive to consume the private hospital service in Hong Kong. Since Kwai Tsing is an area clustered with residents of low income people, it would have a very minimal portion of the self-harm cases would attend private hospital. There would be minimal confounding effect to the generalization of result in Kwai Tsing

With reference to a previous study on the geography of air pollution on mortality in socially deprived urban areas in Hong Kong (Wong et al. 2008), a list of six deprivation related socioeconomic variables were used in the factor analysis with significant loading. The social deprivation index was estimated from the average of these six variables. In our study, the six variables were retrieved from the HK census 2006, which included the proportions (%) of (i) unemployment, (ii) monthly household income < HK$ 2,000, (iii) no schooling or only primary education, (iv) one-person household, (v) never-married status, and (vi) co-tenant, main tenant, and sub-tenancy.

### 2.3. Geo-processing

This manual process assigned a geocode to each case using their registered residential address. The geocode consisted of an X code and a Y code, which enables the precise locations of the residential address on an electronic map. Map layers could be overlaid on this data to facilitate the spatial analysis and related temporal changes. The digital map data was retrieved from the Lands Department of Hong Kong through the HK Jockey Club Center for Suicide Research and Prevention (CSRP). The map data was then transformed to the appropriate coordinate system with various reference layers in the GIS Platform, which included the base map of HK boundary, LSB, and district polygons. In our study, Arc GIS 10 was used as the platform for geoprocessing and map analysis. In addition, GeoDa 0.9 was used to perform the spatial smoothing of the crude standardized mortality ratio (SMR) by Empirical Bayes method.

### 2.4. Analysis

Statscan (Kulldorff and Nagarwalla 1995; Kulldorff et al. 2009; Kulldorff and Kleinman 2015) software was used to perform spatial analysis in the pure spatial and space-time statistics. The scanning window was gradually scanned across space and space-time perspectives and the observed and expected numbers of cases were counted within the window at each location. The scanning window in Statscan was a circle (space) and the cylinder had a circular base (space-time). For pure spatial scanning, the size of the windows varied continuously in size from zero to the upper limit (set as a maximum of 50% of the population) within the study area. For space-time scan statistics, the base was the same as the purely spatial scan moved in space, while the height of the cylindrical window reflected the time period of potential cluster. The window with maximum likelihood was the most likely cluster determined by its p-value. We used Pearson's chi-square test and independent *t*-test to determine the significant difference between cases within the clusters and the rest of Kwai Tsing area. Descriptive and inferential statistics were performed in SPSS 15.

## 3. Results

### 3.1. Population characteristics

A total of 9,526 self-harm records of patients aged 15 years or above from 2004 to 2012 were identified from Princess Margaret Hospital (PMH), Caritas Medical Center (CMC), and Yan Chai Hospital (YCH) (Fig. 1). However, 223 records were excluded due to incomplete address ($n = 59$), care center without registration number ($n = 26$), undefined short form ($n = 1$), no address recorded ($n = 109$), and residence outside of HK ($n = 28$). Overall, 9303 records were manually geocoded and imported to the GIS platform. A base map of HK with 18 districts as the boundaries

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