Economic and environmental factors in Hong Kong suicides

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Abstract

We study the geographical suicide pattern in Hong Kong and examine the influence of socio-economic status on suicides. The geographical distributions of suicide at different age categories (youth, middle-aged, and elderly) varied albeit those of the youth and middle-aged seemed more alike. High population density would lead to more youth and middle-aged suicides while a high proportion of Cantonese speaking residents and low proportion of owner-occupiers would lead to more middle-aged. Four etiological factors of suicides: financial status, environmental setting, self-independence, and homemakers (mainly housewives) were identified. Strong financial status and self-independence with less homemakers would decrease suicide rates at all age categories. Poor environmental factor would however only increase suicide in the youth and middle-aged categories.

Key words

Hong Kong, geographical information system, standardised mortality ratio, suicide

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Suicide has been the leading cause of death in Hong Kong amongst the young people aged 15-24. Besides, elderly suicide rate in Hong Kong is one of the highest in the world (Diekstra, 1992; Yip et al., 1998a, 1998b). Identification of etiological factors of suicides in Hong Kong is therefore of importance and implications on the health care system in Hong Kong.

Hong Kong is one of the most densely population area in the world. In 2000, Hong Kong has 6.8 million people that comprise of mainly ethnic Chinese (constituted 96% of the total population and the majority is Cantonese speaking) living in an area of about 1,078 km^2. Before the Asian financial turmoil, the economic development in Hong Kong during the past two decades is impressive. The Gross Domestic Product (GDP) had increased to US$23,100 in 1999 that made Hong Kong as one of the most affluent city in the world. However, the disparity between the poor and the rich is also widening. The Gini coefficient that measures this disparity was estimated to be 0.52 in 2000 that is considered to be worse than some African countries. It is therefore important to examine if the economic and environment factors have any bearing on suicides in Hong Kong.

Administratively, Hong Kong has been partitioned into 18 districts that may have diverse socio-economic status. The influence of these socio-economic variables on Hong Kong suicides has been discussed in the past (Lester, 1994; Chiu, 1989; Pan & Lieh-Mak, 1989). To the best of our knowledge, however, there has been no empirical

studies conducted on how the socio-economic status of a district affect its suicide rates at different age categories.

The objectives of the study were first to study the geographical distribution of suicides in Hong Kong such that districts that have high suicide risks with respect to different age categories can be identified. Secondary, we examined the influence of the socio-economic variables on suicides and delineated the etiological factors with the use of modern statistical methodology.

Method

The local district system in Hong Kong

For administrative convenience, Hong Kong has been partitioned into 18 District Boards as declared by the Governor-in-Council for district level elections. We adopt these 18 districts as our geographical boundaries because the place of residence of a person who committed suicide was only identified by this partition system. Each district has certain distinctive characteristics. For example, the Central and Western district located at the Hong Kong island is flourished with business industry and also residential flats; the Tuen Mun district located at the New Territories is more residential with some light industrial establishments; and the Islands district is more of 'village' type.

Data

The suicide data considered in this paper included all deaths in Hong Kong during 1991-1996 where the underlying cause was determined as being suicide or self-inflicted injury (E950-E959), as classified under the Tenth Revision (1982) of the International Classification of Disease of the World Health Organization. Besides, a total of 17 district specific socio-economic variables that are potential factors of suicide death in Hong Kong were also solicited from two consecutive census years at 1991 and 1996. All data were made available by the Hong Kong Census and Statistics Department of the Hong Kong SAR, China.

Statistical analysis

To study the suicide distribution among the 18 districts in Hong Kong, the suicide data during the period 1991-1996 were pooled together to improve precision since some of the districts had only a few suicides in a particular year. To quantify suicide risk, an indirect standardization approach was used. Specifically, we computed, for each district, the standardized mortality ratio (SMR) which is defined as

$$\text{SMR} = \frac{\text{observed number of suicides during } 1991-1996}{\text{expected number of suicides during } 1991-1996}$$

The expected number of suicides of a district was computed as the overall suicide ratio weighted by the district population size. Such standardization renders the determination if the number of suicides in a district is unusually high or low (Hennekens & Buring, 1987). Besides, it also avoids the masking effect induced by the possible difference of suicide distribution among different districts. The SMR is invariant to the population

size and distribution, which makes it an attractive choice to study suicide pattern of

Hong Kong. Standard error of SMR can be computed as

$$se(\text{SMR}) = \frac{\text{SMR}}{\sqrt{\text{observed number of suicides during } 1991\text{-}1996}}$$

which becomes smaller when more suicides are observed. Statistical inferences about

SMR can then be performed by utilizing the corresponding usual asymptotic results

(Andersen et al., 1993). Specifically, a 95% confidence interval for SMR of each Hong

Kong district was computed. A district was considered as having an excess or reduced

suicide when the corresponding 95% confidence interval lay completely on the right or

left of 1 respectively; otherwise, the district was considered as having an average

suicide rate.

Since suicide rate in Hong Kong varies with different age categories, we

analyzed the overall population as well as three separate age categories as in Yip

(1997); namely youth (age 10-24), middle-aged (age 25-59), and elderly (age $\geq$ 60). To

examine the geographical distribution of suicide in Hong Kong, all district specific

SMRs at different age categories were computed and mapped onto the 18 districts using

a Geographical Information System (Nobre et al., 1997).

To examine the influence of each socio-economic variable on suicides, the average of

each socio-economic variable collected from the two census years was used. Pearson

correlation coefficient was employed to examine the influence of each individual socio-

economic variable.

Some socio-economic variables were however highly correlated while the study of their individual influence on suicides is worthwhile, an understanding of the underlying factors is also essential. Specifically, we studied important etiological factors of suicide in Hong Kong with respect to the youth, middle-aged, and elderly populations. Common factors that well represent the 17 socio-economic variables (explained at least 90% of total variation) were first identified by using both principal component and maximum likelihood factor analyses followed by a VARIMAX rotation (Hair et al., 1998; Johnson, 1998). Each common factor portrays one distinctive concept of the socio-economic status and is thus a more sensible measure. Scores of the identified factors, the age category, and their interactions were input as the independent variables into a multiple regression model on SMR of suicide with transformation made when necessary (Johnson, 1998). Furthermore, the SMR for the sample of all age groups was also regressed on the identified factors. Diagnostics of all model assumptions were done to ensure valid inference. All significant tests employed a 5% level of significance and SAS 8.0 was used for all analyses (SAS Institute Inc., 1999).

Results

Suicide and socio-economic characteristics of Hong Kong districts

The districts Wong Tai Sin, Kwun Tong, and Tai Po that were more crowded or industrial oriented had an excess overall suicide rate, whereas Central and Western, Wanchai, Eastern, and Shatin that were less crowded or business oriented had a reduced overall suicide rate (Table 1). The geographical distributions of suicide at different age categories however varied albeit those of the youth and middle-aged

seemed more alike (Figure 1). Indeed, among the SMRs of suicides at the three age categories, only youth SMR and middle-aged SMR were significantly correlated (Pearson correlation coefficient = 0.74; P = .001).

The mean SMR of suicide during 1991-1996 for the elderly, the middle-aged, to the youth population were 1.02, 0.97, and 0.94 respectively. The 18 districts had similar composition in average household size, proportions of middle-aged (25-59) residents, Cantonese speaking residents, and homemakers (coefficient of variation < 0.1). However, a large relative variability on the proportion of private residence, and population density (coefficient of variation = 0.73 and 0.97 respectively) among the districts was observed. In particular, Kwun Tong and Wong Tai Sin were two districts which had low proportion of private residence (0.24 and 0.11 respectively) but high population density (53,000/km^2 and 42,000/km^2). Indeed, these two districts also had the highest proportion of unemployed residence (0.023 and 0.024 respectively).

Influential socio-economic variables to Hong Kong suicides

Among the 17 socio-economic variables, high population density would lead to more youth and middle-aged suicides (Table 2). A high proportion of Cantonese speaking residents and low proportion of owner-occupiers would, on the other hand, lead to more middle-aged suicides. These echo with the excess youth and middle-aged suicide in Kwun Tong which was the most crowded district. The excess middle-aged suicide in Wong Tai Sin which had the highest proportion of Cantonese speaking residents and lowest proportion of owner-occupiers. Moreover, large average

household size (e.g. the Tai Po district) and high proportion of residents of age ≥ 15 who attained at most a lower secondary education level (e.g. the North district) tended to relate to more elderly suicides.

Etiological factors of Hong Kong suicides

A total of 5 factors of the 17 socio-economic variables that explained 90% of total variance were identified from the factor analysis irrespective to the estimation methods (principal component and maximum likelihood). Results from principal component method were reported and the corresponding 5 factors explained 93.9% of total variance. The next factor only provided an addition of 2.6% of total variance. After a VARIMAX rotation, the factor loadings of the factors for all the 17 socio-economic variables are shown in Table 3. The five factors which portrayed different concepts were then obtained as follows.

1. Financial status

   This includes high median monthly household income, high proportions of private residence and middle-aged residents, and low proportions of Cantonese speaking residents, residents of age at least 15 who had attained at most lower secondary education level and unemployed residents.

2. Environmental setting

   This includes high population density, high proportions of elderly and retired residents, and low proportions of one unextended nuclear family and students.

3. Self-independence

This includes small average household, and high proportions of one person residents, owner-occupiers, and divorced/separated residents.

4. Homemakers (mainly housewives)

5. Speaking of Chinese dialects other than Cantonese

All the five factors except the speaking of non-Cantonese Chinese dialects were significant in the subsequent regression analysis of log(SMR) (Table 4). The model had an overall significance level of less than 0.0001 and explained 68.1% of total variance of SMR for suicide. Exhaustive diagnostic checks revealed no significant model discrepancies. There were less youth suicides than the other two age categories on average. Stronger financial status and self-independence with lesser homemakers in a district would reduce its suicide rates for all age categories. The environmental factor, however, only influenced suicide in the youth and middle-aged categories. A crowded population with more retired residents had a higher risk in both youth and middle-aged suicides. Again, the socio-economic status had similar influence on youth and middle-aged suicides. The regression of overall SMR (in logarithmic scale) on the five factors revealed a similar pattern with the elderly suicides (Table 4).

The district with the highest financial status, least crowded population, strongest self-independence and lowest proportion of homemakers were Wan Chai, Tuen Mun, Yau Tsim Mong, and Islands respectively (Figure 2). Indeed, these districts did not show any excess suicides during 1991-1996. On the other hand, districts with either excess youth or middle-aged suicides were Kwun Tong, Wong Tai Sin, and Sham Shui

Po that tended to have weak financial status, poor environment setting, less self-independence, and more homemakers.

Discussion

By incorporating modern statistical methods, four uncorrelated etiological factors of Hong Kong suicides, namely financial status, environmental setting, self-independence, and homemakers which measure four distinctive aspects of the socio-economic status of a district were identified. There were relatively more suicides in districts with a low financial status, weak self-independence, and more homemakers. A district with poor environmental setting, on the other hand, tended to have more youth and middle-aged suicides but seemed not relate to elderly suicides. These findings are all consistent with the results obtained during the study of individual influence of the socio-economic variables on suicides (Chi et al., 1998; Yip, 1997; Yip et al., 1998a, 1998b).

Financial status and self-independence are perhaps the most intuitive factors of suicides. No matter at which age category, the higher the financial status, the less likely are suicides committed. One of the key elements of financial status is unemployment (here refers to those who are seeking jobs) that has been shown to have an adverse effect on the well being of a person's mental health (Hawton et al., 1988). In Hong Kong, unemployed people can opt for subsidy from the government. The amount is however too small to barely support a living. Indeed, the suicide rate of the unemployed in Hong Kong was three times higher than that of employed (Yip, 1997). The impact of

unemployment needs however more careful attention as distinction would be desirable to be made between those who never worked and those who have lost their positions; between those who have enough money and those who need to work for minimum living standard (Platt, 1984). This is not studied in this article because of the lack of relevant data. On the other hand, self-independence measures the strength of one's willingness to earn one's own living. In other words, people with higher independence would tend to be mentally stronger or have an independent lifestyle. As a result, they would be less inclined to commit suicide.

Districts with more homemakers had a higher rate of suicide. Homemakers refer to people who "work" but not paid. They are often financial dependent and/or have a limited social network. As a consequence, the social characteristics of homemakers are deemed to be different from those of the working group. Indeed, it was suggested that marriage did not benefit Hong Kong women as much as the male counterparts (Yip, 1998).

Environment setting acted differently at different age categories. More senior residents in limited living area tended to yield more youth and middle-aged suicides but seemed not have influence on elderly suicides. It seems to suggest that environmental constraint to people who are more physically active would conceal a higher suicide rate while it may not be relevant to the elderly who prefer a strong neighborhood relationship and network.

Our analyses were made upon pooling the data collected at 1991 and 1996. Separate analyses for the 1991 and 1996 data are possible to study the change of suicide pattern in Hong Kong. There were however too few suicides (less than 5) in certain districts especially amongst the youth. This would have significant impact on both the precision of the SMR estimates and the validity of the asymptotic results that assumes a large sample size. While there was a macro trend in the change of socio-economic status of Hong Kong during 1991-1996, the differentials among the districts were expected to remain stable and thus our results should well reflect the actual situation. It is worthy however to note the implications of the hand-over from Britain to China, as well as the Asian economic turmoil since 1997. The suicide pattern might be different due to the change of sovergnity and the impact of financial burden, due to an increase in unemployment arising from the Asian financial crisis. For instance, people who were repaying their housing mortgage would have been under more stress against salary cuts and the possible job loss. The influence of the proportion of own-occupiers on suicides might have been attenuated or even become negative. A further study would therefore be desirable upon the census year at 2001. Suicide is a very complex phenomenon. It can be viewed from a macro perspective or in a micro perspective to look at the individual's risk factors (Chi et al., 1998; Durkheim, 1952; Ho et al., 1998). The present analysis has made use of information on a district level to examine the etiological factors that are related to the occurrence of suicides at different age categories. Factors such as financial status, homemaking and self-independence are also consistent with the risk factors at individual level. Having examined the geographical distribution of suicides with districts having excess suicides identified and mapping of

the 18 districts in accordance with the four identified etiological factors, appropriate resources should be properly allocated to those districts with relatively high suicide risk.

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Table 1. Suicide rates of the 18 districts in Hong Kong during 1991-1996.

District	Standardized Mortality Ratio (95% confidence interval)			
	Youth (10-24)	Middle-aged (25-59)	Elderly (at least 60)	Overall
Hong Kong Island				
Central & Western	1.01 (0.50, 1.52)	0.92 (0.73, 1.11)	0.69 (0.48, 0.89)[2]	0.84 (0.70, 0.98)[2]
Wan Chai	0.56 (0.07, 1.06)	0.77 (0.56, 0.98)[2]	0.79 (0.55, 1.04)	0.76 (0.61, 0.92)[2]
Eastern	1.02 (0.69, 1.35)	0.89 (0.76, 1.02)	0.82 (0.67, 0.96)[2]	0.87 (0.78, 0.97)[2]
Southern	0.72 (0.34, 1.09)	1.01 (0.80, 1.21)	0.95 (0.71, 1.19)	0.95 (0.81, 1.10)
Kowloon				
Yau Tsim Mong	1.22 (0.68, 1.75)	1.09 (0.88, 1.30)	0.82 (0.62, 1.02)	0.99 (0.85, 1.13)
Kowloon City	0.87 (0.51, 1.24)	0.98 (0.81, 1.14)	0.85 (0.67, 1.03)	0.92 (0.80, 1.03)
Sham Shui Po	0.97 (0.57, 1.38)	1.21 (1.01, 1.40)[1]	0.89 (0.72, 1.06)	1.05 (0.92, 1.17)
Kwun Tong	1.44 (1.09, 1.80)[1]	1.18 (1.03, 1.33)[1]	1.13 (0.96, 1.29)	1.19 (1.08, 1.30)[1]
Wong Tai Sin	1.27 (0.84, 1.70)	1.30 (1.10, 1.50)[1]	1.24 (1.05, 1.44)[1]	1.27 (1.14, 1.40)[1]
New Territories				
Kwai Tsing	1.08 (0.74, 1.41)	1.14 (0.97, 1.32)	1.07 (0.87, 1.28)	1.11 (0.99, 1.23)
Tsuen Wan	0.77 (0.38, 1.17)	0.97 (0.77, 1.17)	1.07 (0.79, 1.36)	0.98 (0.83, 1.13)
Tuen Mun	0.78 (0.49, 1.08)	0.90 (0.74, 1.05)	1.27 (0.97, 1.57)	0.97 (0.84, 1.10)
Yuen Long	0.72 (0.36, 1.09)	0.78 (0.60, 0.96)[2]	1.13 (0.86, 1.40)	0.90 (0.76, 1.04)
North	0.85 (0.37, 1.33)	1.05 (0.80, 1.30)	1.39 (1.02, 1.76)[1]	1.14 (0.94, 1.33)
Tai Po	1.17 (0.67, 1.67)	1.09 (0.86, 1.32)	1.39 (1.03, 1.75)[1]	1.19 (1.01, 1.37)[1]
Shatin	0.96 (0.67, 1.25)	0.81 (0.68, 0.94)[2]	0.87 (0.69, 1.06)	0.85 (0.75, 0.95)[2]
Sai Kung	0.99 (0.40, 1.57)	0.79 (0.56, 1.03)	0.96 (0.59, 1.33)	0.87 (0.68, 1.05)
Islands	0.53 (0.20, 1.25)	0.58 (0.24, 0.92)[2]	1.03 (0.49, 1.57)	0.74 (0.46, 1.02)

[1]indicates excess suicide, i.e. SMR is larger than 1 at .05 level of significance.

[2]indicates reduced suicide, i.e. SMR is smaller than 1 at .05 level of significance.

Table 2. Socio-economic variables that were influential to the suicide of the youth, middle-aged, elderly, and overall population respectively[1]

	Positively correlated variable (r)	Negatively correlated variable (r)
Youth SMR	• Population density (0.64)** • Proporption of Cantonese speaking residents (0.53)*	None
Middle-aged SMR	• Proportion of Cantonese speaking residents (0.65)** • Proportion of unemployed residents (0.69)** • Population density (0.62)**	• Proportion of owner occupiers (-0.70)**
Elderly SMR	• Proportion of one unextended nuclear family (0.58)* • Average household size (0.61)** • Proportion of residents of age ≥ 15 and attained at most a lower secondary education level (0.77)** • Proportion of homemakers (0.48)* • Proportion of students (0.66)** • Proportion of unextended residents (0.47)*	• Proportion of private residence (-0.72)** • Proportion of one person residence (-0.54)* • Median monthly household income (-0.63)** • Proportion of residents of age 25-59 (-0.80)**
Overall SMR	• Average household size (0.50)* • Proportion of Cantonese speaking residents (0.68)** • Proportion of residents of age ≥ 15 and attained at most a lower secondary education level (0.64)** • Proportion of homemakers (0.56)* • Proportion of unemployed residents (0.74)**	• Proportion of owner-occupiers (-0.74)** • Median monthly household income (-0.54)* • Proportion of residents of age 25-59 (-0.57)*

[1] r indicates the Pearson correlation coefficient.
*p-value < .05
**p-value < .01

Table 3. Rotated factor loadings of the factor analysis.

	Factor				
	1	2	3	4	5
1. Proportion of private residence	0.666	0.331	0.544	0.150	0.177
2. Proportion of one person residence	0.094	0.428	0.835	-0.294	-0.105
3. Proportion of one unextended nuclear family	-0.128	-0.699	-0.629	0.282	0.048
4. Proportion of owner-occupiers	0.408	-0.289	0.677	-0.283	0.383
5. Average household size	-0.245	-0.412	-0.827	0.231	0.012
6. Median monthly household income (HK$)	0.959	0.057	-0.044	-0.234	0.053
7. Proportion of residents of age 25-59	0.868	0.199	0.344	-0.067	0.134
8. Proportion of residents of age ≥ 60	0.102	0.948	0.215	-0.041	-0.061
9. Proportion of Cantonese speaking residents	-0.570	0.153	-0.337	0.548	-0.359
10. Proportion of residents speaking non-Cantonese Chinese dialects	0.174	0.040	-0.104	0.041	0.970
11. Proportion of divorced/separated residents	0.405	0.164	0.783	0.234	-0.230
12. Proportion of residents of age ≥ 15 and attained at most a lower secondary education level	-0.930	-0.098	-0.267	0.130	-0.081
13. Proportion of homemakers[3]	-0.324	-0.204	-0.153	0.848	0.077
14. Proportion of students	-0.395	-0.841	-0.254	0.227	-0.027
15. Proportion of retired residents	-0.198	0.913	0.129	-0.156	-0.031
16. Proportion of unemployed residents[4]	-0.727	0.403	-0.269	0.325	-0.030
17. Population density (/km²)	0.015	0.853	0.065	0.389	0.101
Percentage of variance explained	27.0	26.5	21.7	10.6	8.0
Cumulative percentage of variance explained	27.0	53.5	75.2	85.9	93.9

[1]SMR indicates standardized mortality ratio, i.e. the ration of observed number of suicides to the expected number of suicides.
[2]CV indicates the coefficient of variation, i.e. SD/mean.
[3]Homemakers refer to persons who look after home without pay.
[4]Unemployed residents refer to persons of age ≥ 15 who are capable to work and seeking jobs.

Table 4. Etiological factors of age category specific suicide in Hong Kong[1]

Factor	Estimate (95% confidence interval)			
	Youth	Middle-aged	Elderly	Overall
	$R^2 = 68.1\%$			$R^2 = 76.8\%$
(Intercept)	-0.094 (-0.171, -0.018)	NS	NS	NS
Financial status		-0.081 (-0.126, -0.035)		-0.078 (-0.125, -0.031)
Environmental setting	0.087 (0.008, 0.165)	0.096 (0.017, 0.175)	NS	NS
Self-independence		-0.077 (-0.123, -0.032)		-0.073 (-0.120, -0.026)
Homemakers		0.095 (0.049, 0.140)		0.073 (0.026, 0.119)
Speaking of non-Cantonese Chinese dialects		NS		NS

[1]log(SMR) was used as the dependent variable of the multiple regression model and NS indicates non-significance at .05 level of significance.

Figure Captions

Figure 1. Standard mortality ratios of suicide in Hong Kong during 1991-1996

Figure 2. Economic and environmental status of the 18 districts in Hong Kong
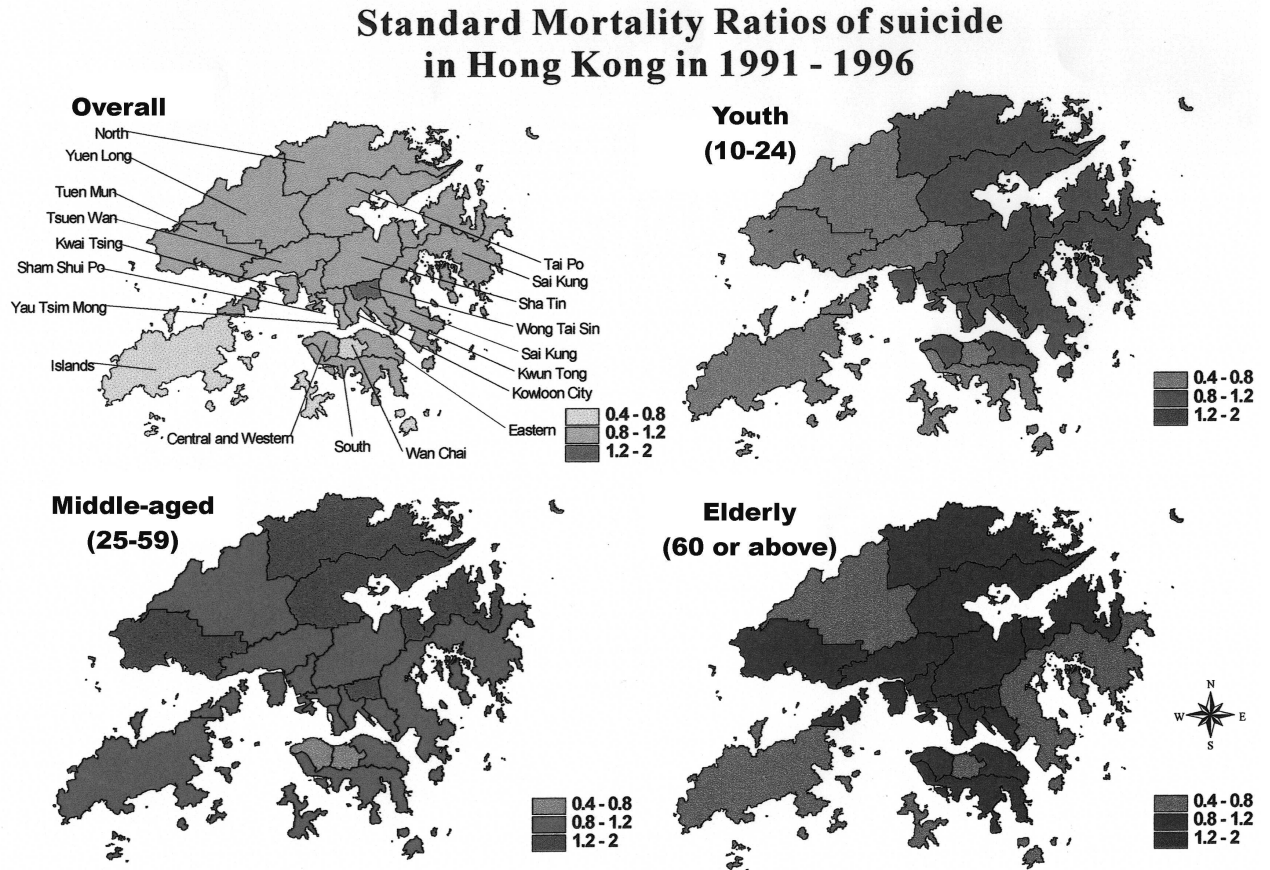
Figure 1.

Standard Mortality Ratios of suicide
in Hong Kong in 1991 - 1996

Figure 2.

(a)

(b)