A Study on Factors Affecting the Drug Abuse Trend in Hong Kong

- Commissioned by Action Committee Against Narcotics (ACAN)

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February 2001

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Executive Summary

1. This study attempts to identify, at a societal level, socio-economic factors associated with drug abuse trends in Hong Kong. Due to the possible ecologic bias, some further individual level data are needed to further clarify the implications.
2. Putative social and economic factors were identified based on established social theories of drug abuse, and their statistics retrieved from relevant government departments. Regression analyses were conducted using the CRDA (Central Registry of Drug Abuse) statistics (1980-1998) as indicators of drug abuse trends. Sophisticated statistical modeling techniques, including autoregressive modeling, multiple regression, Poisson regression and transfer function model, were used.
3. The results confirmed three dominant drug abuse trends: juvenilization, feminization and the increased incidence of psychotropic abuse. The analysis also shows that these trends are not recent phenomena, and many of these trends can be traced back to 1980s.
4. Several social and economic factors are found to be associated with specific drug abuse trends. The overall drug abuse trend is positively associated with unemployment rate. The female incidence trend and the psychotropic incidence trend are associated with rate of youth offence.

5. Despite repeated attempts to construct a statistical model to explain the fluctuations of drug abuse problem in Hong Kong, the research team cannot identify a single model that can satisfactorily capture the phenomenon. This may be due to two reasons. First, factors not readily available (e.g. cultural attitude towards drug abuse) cannot be studied using statistical modeling. Second, it is possible that drug abuse trends in Hong Kong are determined by a combination of factors, each of which have a small additive effect on the overall trend and they are all confounded together. If this is true, it will be difficult to model the drug abuse trends using regressive statistical techniques on the CRDA type of data.

6. It is important to note that statistical association does not equate causation. This research was designed to examine macroscopic association, rather than to provide explanations for the observed relationships. Hence, more studies are needed to understand the meanings behind our findings. In particular, it would be worthwhile to investigate the meanings of unemployment among individuals who are susceptible to drug abuse, and to ask what can be done to uncouple the association. Such understandings may help confirm causative relationship and may eventually lead to effective and evidence-based interventions.

1 Introduction

1.1 In early 1990s, Hong Kong was hit by a rising tide of drug abuse. Between 1991 and 1994, the incidence of drug abuse, as measured by the number of persons newly reported to the Central Registry of Drug Abuse (CRDA), has increased by 100%. During the same period, the incidence of drug abuse among the less than 21-year-old increased by more than three folds. Amidst these upward trends, there was also a sharp increase of female drug abusers of all ages, and an increased popularity of psychotropic drugs among young drug users. This rising trend was taken seriously by the Hong Kong Government and multi-departmental Forward Action Plans were announced. The concerted anti-drug efforts appeared to be effective and most rising trends of drug abuse reversed in 1995 and 1996.

1.2 It was against such historical background that this research was commissioned. At that time, while there were several studies of the personal characteristics and individual risk factors of drug abuse in Hong Kong, there has been virtually no data on what governs the fluctuations of drug abuse trends within the local contexts. The former helps identification and possibly treatment of individuals drug abusers, but the latter is essential when it comes to population based prediction and intervention.

1.3 A comprehensive understanding of drug abuse trend within broader

socioeconomic and cultural perspectives would be invaluable for social and drug policy makers as well as health care planners for two key reasons. First, knowing what determines drug abuse trends would help forecast and perhaps even provide timely alert of likely surges. Second, such understandings may shed insight as to what can be done at a societal level in combating drug problems.

1.4 As such, it would be important to appreciate that this is not another study of the characteristics of drug abusers or risk factors of drug abuse. This study does not focus on drug abuse individuals or their immediate physical and interpersonal environment. Instead, this study aims to provide a different kind of data that would contribute to a more complete understanding of drug abuse trends in Hong Kong. The subjects of the investigation are hence the Hong Kong society, her drug abuse trends, and the larger social, economic and cultural environment.

1.5 In understanding what shapes drug abuse trends, a number of social theories are relevant. An in-depth discussion of such theories would be beyond the scope of this report, but a succinct summary is provided for quick reference (figure 1.1). As we will report in subsequent chapters, only some putative models can be tested.

1.6 This study relies solely on the CRDA (Central Registry of Drug Abuse) system for longitudinal drug abuse trends. The research team is fully aware of the merits, as well as the limitations, inherent to population based surveillance system; and has

considered the possibility of alternative drug abuse indicators. However, it did not take long for the research team to confirm that that the CRDA statistics are the only longitudinal trend indicators available. Left with no alternative, the CRDA data were used but a small-scale validation was conducted to assess the degree of potential bias.

1.7 The study was conducted between April 1998 and June 2000. Apart from the investigators, two research assistants (Ms Joanne Chun and Ms Carrie Yam) assisted data collection and statistical analysis.

Figure 1.1 Drug Abuse Etiological Theories

Orientation	Theories	Concepts	Explanations	Testable Correlates of Drug Abuse Trends	Data source
Sociological	Deviance Theory	drug abuse and crimes are both deviant behaviour	drug abuse is recognised to be associated with criminal activities	• crime rate • youth delinquent rate	Police Dept, Judiciary Dept
Sociological	Control Theory	failure of social control and loss of social cohesiveness	people conform and do not use drugs because society/ family is able to control their behaviour; social disorganisation (Cheung and Ch'ien, 1996) weakens social control, increases deviance	• family violence • divorced rate • single parent families • child abuse statistics • school dropouts	Census Dept, Police Dept, Social Welfare Dept, Judiciary Dept, Education Dept.
Sociological	Cultural Transmission Theory	differential association with deviants	socialisation with deviant subculture increases deviance, including drug abuse	• less than age 18 people reported missing • delinquent crime rate	Census Dept, Judiciary Dept, Police Dept.
Sociological	Durkheim's Theory on Suicide	lack of collective order produces anomie and deviant behaviour	deviance is commoner amidst major social changes and political crisis	• students suicide and parasuicide rates	Opinion Polls, Education Dept
Sociological	Structural-Strain Theory	social strains cause people to deviate	substantial gap between socially approved goals and the availability of social approved means of achieving them	• proportion of adult/ youth population with "sub-optimal" education (e.g. less than F3) • labour force participation rate • unemployment rate	Census Dept, Education Dept, Social Welfare Dept.

				• underemployment rate • size of low income strata • population below the poverty line • population on social security (e.g. CSSA) • Stock Index/Wage Index • Domestic Properties Price Index/ Wage Index • Consumer Price Index/ Wage Index	
Economic			economic growth favours the demand and supply of drugs; economic recession causes psychological depression, which in turn causes drug abuse	• economic growth rate • GNP • GDP, GDP per person • inflation rate • consumer index • industrial production index • unemployment rate • underemployment rate	Census Dept.
Economic		Drug as a good that follows supply and demand economy	drug price and seizure statistics are indirect indicators of supply	• drug price • seizure statistics • narcotics production in Golden Triangle (estimates)	Narcotics Division, Police Dept, United Nations reports
Medical	Communicable Disease Model	drugs as an infectious agent	the arrival of a new drug (infectious agent) in a un-	• the timing of introduction of new substances of abuse	Experienced front-line workers, CRDA

			immunised community will increase the overall rate of addiction (infection) until immunity (awareness to harms of newly introduced drugs) develops	• the timing of corresponding modification of drug education programme	records, Narcotics Division
Empirical	Stage Theory		Smoking and drinking as gateway drugs	• rate of smoking in the population and among teenagers,	Census Dept, Dept of Health
Empirical	Rising trend in psychotropic substance abuse/ Supply and demand theory	increased supply through unscrupulous prescription from private physicians and illegal sales from drug stores	the trend of import of psychotropic substances (e.g. hypnotics and cough medicine) will correlate (or even predate) the trend of psychotropic substance abuse, and may be used as a "smoke alarm"	• import statistics of various psychotropic substances (benzodiazepines, cough medicine, barbiturates)	Health Dept
Sociological	Rising trend in female drug abuse	gender equality	equalisation of gender will reduce the discrepancies in the rate of drug abuse between men and women	• proportion of work force being women, • employment status of women population	Census Dept
Sociological	Rising trend in female drug abuse	impaired social control and socialisation in female population; findings of risk factors studies of drug abuse at individual level		• divorce rate • history of sexual abuse before age 16 • criminal records, delinquent crime • rate of induced abortion	Census Dept, Social Welfare Dept, Police Dept, Education Dept, Family Planning Service

Empirical	Triad Society Activities	drug trafficking is mostly triad controlled	increased triad activities in a society will include increased drug trafficking and pushing	• conviction rate on trafficking • seizure statistics	Police Dept, Judiciary Dept
Empirical	Government Action		Assertiveness of the anti-drug action	• government summits meetings • introduction of new anti-drug measures	Narcotics Division.
Others	Vital Statistics and Others			• age structure • new immigration • number of tourists	Census Dept.

2 Research Objectives

The research proposal encompasses the following study objectives:

- To identify social, cultural, economic and legal factors contribute to the abuse of licit and illicit drugs in Hong Kong.
- To enquire at a macroscopic level the underlying reasons that have governed the general trend and its likely influence on the future patterns of drug abuse in Hong Kong.
- To identify specific social, cultural and economic variables that contribute to the recent rising trend in the number of female drug abusers and psychotropic substance abusers.
- To examine variations of these factors in respect of time and identify how they might affect future trend of drug abuse

3 Methodology

3.1 CRDA data set

3.1.1 A detailed evaluation of the CRDA statistics deserves a separate study and is beyond the scope of this study. However, the research team feels that it is important to establish the statistical reliability of the CRDA system. Here reliability is used in a technical sense, meaning the repeatability of the measurements.

3.1.2 Using a variety of statistical modeling techniques, the team assessed the internal consistency as well as the reliability of the data set. This part of the study was subsequently extended into an evaluation of the CRDA system, conducted by a member of this research team (Dr. Tai-shing Lau) and Professor Char-Nie Chen. As, at time of writing, the evaluation project is still ongoing, this report will not discuss the issue of reliability any further, except to say that the research team has confidence in using the CRDA statistics as indicators of drug abuse trends.

3.1.3 The research team also corroborated the CRDA statistics with the school survey results. It is important to note that the corroboration is qualitative rather than quantitative, as the two monitoring systems measure quite different sectors of local drug abuse scene. The research team is fully aware of the limitations of

this assessment, but feels that given the lack of appropriate standard criterion this comparison is nonetheless better than no validation.

3.2 Identification of Potential Macroscopic Factors for Investigations

3.2.1 In our original proposal, we raised the issue that data collection and in-depth analysis of risk factor were time consuming, and suggested to maximise the available time by forming an expert panel to advise on the selection of potential factors for analysis. (Candidate factors and underlying theories for consideration are summarized in Table 1.1.) However, as the study unfolded, the team found that data were not available for several proposed risk factors and the research assistant could cope with the remaining risk factors with no difficulties. Hence, the research team decided that all available factors should be studied and an expert panel was unnecessary.

3.3 Statistical Analysis

3.3.1 The relationship between the studied factors and the trend of drug abuse was examined by inferential statistical methods. The historical data of the studied factor were obtained from the Census and Statistics Department, the Education

Department, the Police Force, Health Department, and other relevant government bodies. To ensure adequate data points for analysis, quarterly statistics were used when available, and imputed when necessary.

3.3.2 The numbers of newly reported drug-using persons per year or per quarter were corrected by the relevant populations. The incidence rates were used as dependent variable in the analysis. Incidence rate (in contrast to prevalence rate) is generally regarded as a more valid indicator of the etiological forces. Prevalence rate (number of existing users corrected by population size) reflects both new case formation as well as the course (e.g. rates of mortality and recovery) of the studied phenomenon.

3.3.3 Apart from examining the effects of putative risk factors on overall drug abuse trend, the same analyses were conducted on female drug abuse trend and psychotropic substance abuse trend.

3.3.4 The incidence rate is the number of persons having drugs divided by the number of people at risk. It can be viewed as the mean of large number of binary variables. Thus, by the central limit theorem, it is approximately normal and the usual multiple regression can be used. Poisson regression can be used because the numerator of the incidence rate is approximately Poisson distributed. In the

literature, both distributions have been used in studying incidence rate. The model building is quite empirical and data-model dependent. We have searched extensively on international literature, there are essentially no simple model to relate incidence rate to macro-level variables. By using both possible models, we may see more possible interpretations in this relationship.

3.3.5 A variety of statistical strategies were used to model the drug abuse trend. In particular, multiple regression, Poisson regression, and Pearson scale were used to construct the best statistical models that explain the drug abuse trends.

3.3.5.1 ***Multiple Regression***

3.3.5.1.1 Simple regression models the relationship between x and y with the equation $E(y|x) = ß_0 + ß_1x$ where $E(y|x)$ represents the expected value of y given x and $ß_0$ and $ß_1$ represent regression coefficients (the intercept and slope, respectively). Multiple regression extends this model to include any number ("k") of independent variables with the equation $E(y|x_1, x_2,...,x_k) = ß_0 + ß_1x_1 + ß_2x_2 + ...+ß_kx_k$, where $E(y| x_1, x_2,...,x_k)$ represents the expected value of y given the values $x_1, x_2,...,x_k$, $ß_0$ represents the intercept coefficient, and $ß_1, ß_2, ..., ß_k$ represent the slope coefficients associated with variables $x_1, x_2,.. x_k$, then the model formulation

$$y_i= ß_0 +ß_1x_{1i} + ß_2x_{2i} + ...+ß_kx_{ki} + \varepsilon_i \quad (i=1, 2, \ldots, n; n \geq k+1)$$

The assumptions of the multiple regression are:

1. The model specification is given by above equation, y_i is related linearity to the regressor variables, $x_1, x_2,...,x_k$.
2. a) The error term has 0 expected value, constant.variance.

   b) Errors corresponding to different observaions are independent and therefore uncorrelated.

   c) The error variable is normally disturbuted.

3.3.5.1.2 The assumption 2(b) often breaks down in time-series studies (As a set of longitudinal count, the mutiple regression models using CRDA dataset may experience such problem). When the error terms from different time periods are correlated, we say that the error term is serially correlated. Serial corelation occurs in time-series studies when the errors associated with observations in a given time period carry over into future time period. For example, if we are predicting the growth of stock dividends, an overestimate in one year is likely to lead to overestimates in succeeding years.

3.3.5.1.3 We assume that each of the error terms in a linear regression model is drawn from a normal population with 0 expected values and constant variance, but that the errors are not independent over time. Since serial correlation is

usually persent in time-series data, we use a subscript of t (in place of i) and assume that the total number of observations is T. The model is

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \ldots + \beta_k x_{kt} + \varepsilon_t \quad (t=1, 2, \ldots, T)$$

$$\varepsilon_t = \rho\varepsilon_{t-1} + v_t \qquad 0 \le |\rho| < 1$$

3.3.5.1.4 Where v_t is normally distributed and is independent of other errors over time, as well as being independent of ε, and ε_t which is also normally distributed but is not independent of other errors over time.

3.3.5.1.5 Both forward and stepwise procedures are adopted in model selection procedure, the possibility of multicollinearity in the final model is reduced..

3.3.5.2 ***Poisson Regression***

3.3.5.2.1 Poisson regression models are applicable in problems in which the response variable represents the number of events occurring in a fixed period of time. One instance is the number of seizures in a given period of time. Because of the discrete and non-negative nature of count data, a reasonable assumption is that the logarithm of the expected count is a linear function of the explanatory variables, so that: $\text{Log } E(Y_i) = x'_i\beta$

3.3.5.2.2 Here, the regression coefficient for a particular explanatory variable can be interpreted as the logarithm of the ratio of expected before and after a one

unit increase in that explanatory variable, with all other explanatory variables held constant. The term 'Poisson' refers to the distribution for counts derived by

$$P(y) = \exp(-\mu)\mu^y/y! \qquad y = 0, 1, \ldots$$

3.3.5.2.3 In a typical Poisson regression model, assumptions include

(1) that the logarithm of the disease rate changes linearly with equal-increment increases in the exposure variables;

(2) that changes in the rate from combined effects of different exposures or risk factors are multiplicative;

(3) that at each level of the covariates, the number of cases has variance equal to its mean;

(4) that observations are independent.

3.3.5.2.4 Since this is a non-linear model, we might want to see the likelihood-based confidence limits for the estimates. However, the major problem is the estimation dispersion parameter, $\text{var}(y)/\mu$.

3.3.5.2.5 For the Poisson distribution the variance is equal to the expectation. However, count data often displays overdispersion, i.e, $\text{var}(y) > \mu$. There are two ways to handle this: To take a quasi-likelihood approach to data,

assuming that the variance is not μ, or to assume that there is heterogeneity in the mean, so that this parameter μ itself is assumed to follow a distribution.

3.3.5.2.6 Although the estimate of the dispersion parameter is often used to indicate overdispersion or underdispersion, this estimate may also indicate other problems such as an incorrectly specified model or outliers in the data.

3.3.5.2.7 We apply the Poisson regression model to the numerator of the number of drug abusers in a year, which is a count. But the denominator is the population of Hong Kong of the rescpective midyear. In Poisson regression, this number is conditioned to have coefficient one. Thus, essentially, we have the Poisson regression applying to drug abuse rate.

3.4 Simple Comparison

Out research team tries to explore different possibilities so different models are used. In this case, the data are not randomly collected and the relevant aggregate factors are collected separately. Even in the case that nice data are available, different models should be tried. The famous motto is: "all models are wrong and some models are useful".

The regression models are the most relevant model in deriving the relationship between the factors and the incidence of drug abuse. The Poisson regression

model is very popular model in epidemiology when dealing with count. Since the data is relatively large, the normal regression model is also tried.

Simply put, the regression modeling with error terms serially correlated is better suited for time series data when successive data point tends to be related. The Poisson regression is more useful for modeling events (count data) that are rare or uncommon.

3.5 Other Methods

The research has also attempted other modeling strategies, including survival analysis. To avoid unnecessary confusions, in this report, only the findings of multiple regressions and Poisson regressions are presented.

As required by the research sub-committee, some additional analyses are performed on

(a) Smoking data from school surveys

(b) Transfer function

(c) Selected indicators in the report of 'Social Development Index in Hong Kong'. However, the number of observations of each indicator is not large enough for the purpose of regressions. Therefore only correlation analysis and simple plots are produced.

3.6 Predictive Models

The variations of the risk factors in respect of time were examined. Upon the completion of inferential analysis, the possibility of forming a predictive model was considered based on the statistical variance best explained by the derived model.

4 Results

4.1 Drug Abuse Trends in 1980-1998

4.1.1 The drug abuse trends of the first four years of the CRDA system (1976-1979) were treated as training or unsaturated period; and were not included for analysis.

4.1.2 The prevalence (all reported cases) and incidence (newly reported cases) rates of drug abuse over the period 1980-1998 were adjusted by the population growth and were summarized in figure 4.1.

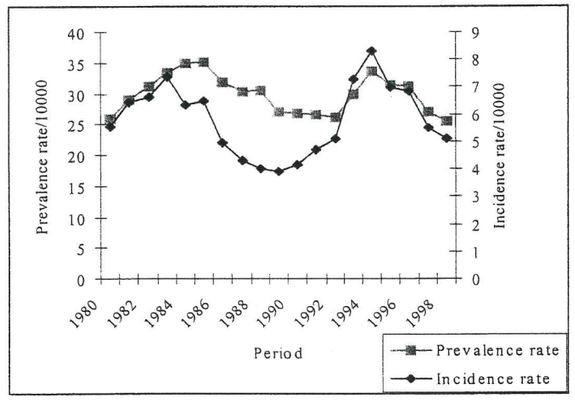


Figure 4.1 Overall Incidence and Prevalence Rates

4.1.2.1 The incidence and prevalence trends parallel each other over the study period. There were rising trends between1980 and mid-1980's. Both trends fell in late 1980s. Afterward, the trends rose again and reached a peak in 1995. Between

1996 and 1998, there was a persistent decrease in both incidence and prevalence rates.

4.1.2.2 The fluctuations of incidence trend were more pronounced than those of the prevalence trend. This is because the prevalence trend is buffered by existing cases, which tend to last for more than a few years.

4.1.2.3 The proportion of new cases contributing to the CRDA system varied from 13% to 24% of the total unique cases identified per year. The percentage dropped from around 20% to about 10% between 1983 and 1989. It reached 25% in 1995, and returned to around 20% in 1998 (figure 4.2).

Figure 4.2 Percentage of newly reported cases

4.1.2.4 The incidence rates of female drug abuse fluctuated between 1.0 to 2.2 per 10,000 during the period 1980 -1992. The trend rose sharply between 1992 and 1994; and reversed around 1995 (figure 4.3). During the studied period, female cases contributed towards an increasing portion of all reported cases (figure 4.4).

Figure 4.3 Incidence rates of female drug abusers

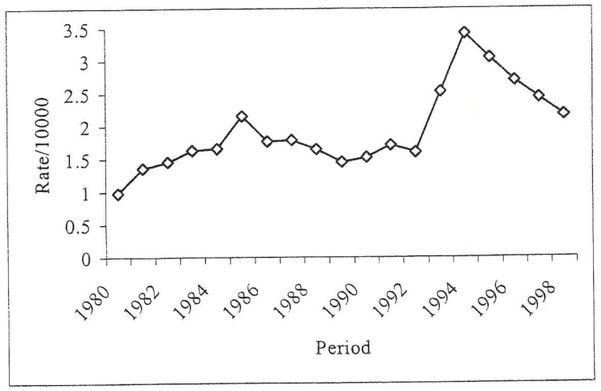
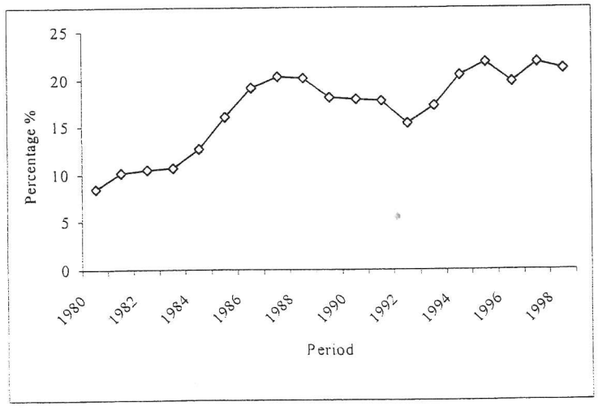
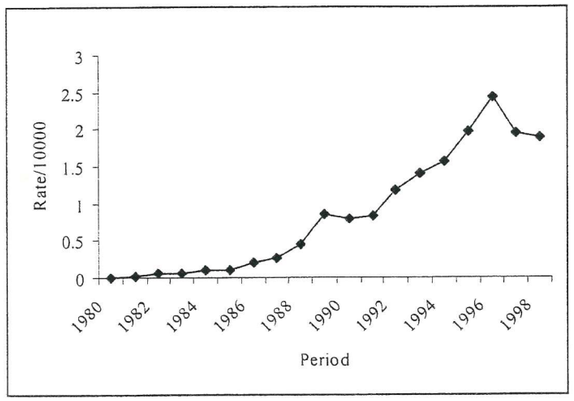


Figure 4.4 Percentage of newly reported female abusers



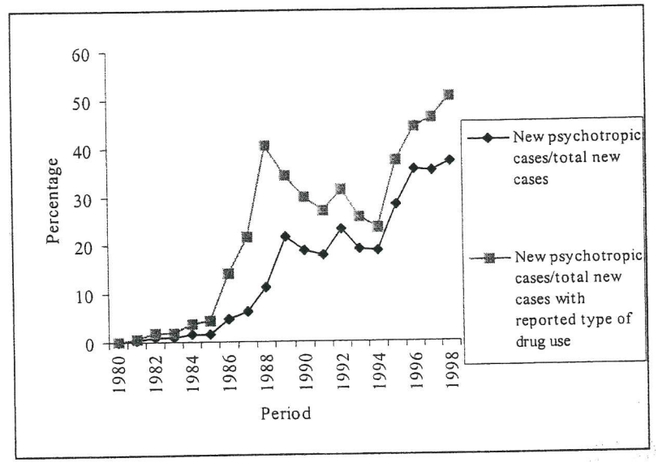
4.1.2.5 As for psychotropic substance abuse, there was a slow but steady rise in incidence between 1980 and 1988. Thereafter, the increase in psychotropic substance abuse took on an accelerated pace. After almost 10 years of uncurbed growth, the linear trend reversed in 1997 (figure 4.5).

Figure 4.5 Incidence rates of psychotropic substance cases



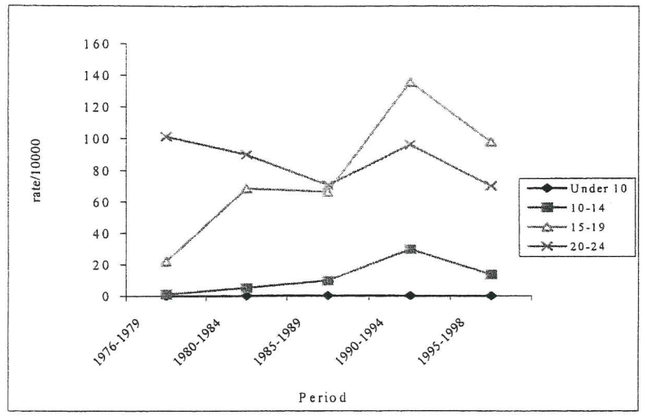
4.1.2.6 In the period 1980 and 1989, the percentage of psychotropic substance cases among all newly reported cases increased quickly. The percentage dropped during period 1990 and 1994, then increased rapidly again from 1995 to 1998 (figure 4.6).

Figure 4.6 Percentage of psychotropic substance cases



4.1.2.7 The overall incidence trend was stratified by ages. Among those aged 10-14, an upward trend was observed until period 1985-1989. The incidence rate of the age group 15-19 during the period 1990-1994 was 7 times that of the period 1976-1979. Among those aged between 20-24, the incidence trend decreased over in 1980s, but kicked up in early 1990s. The trend fell again during 1995-98 (figure 4.7).

Figure 4.7 Incidence rates of newly reported case aged under 25



4.1.2.8 In late 1990s, except for those aged less than 15, the younger the age groups, the higher the incidence rates of drug abuse.

4.1.2.9 Among those aged 25 or above, the incidence rate dropped substantially in early 1980s. The trends remained relatively stable afterwards (figure 4.8). The incidence trends stratified by age and substance of abuse do not yield additional information with the following exception. It is observed that, with the exception of those aged less than 15, the incidences of psychotropic substance abuse have been constantly on a rise. Besides, the younger the age group, the sharper the rise (figure 4.9).

Figure 4.8 Incidence rates of newly reported case aged 25 and above

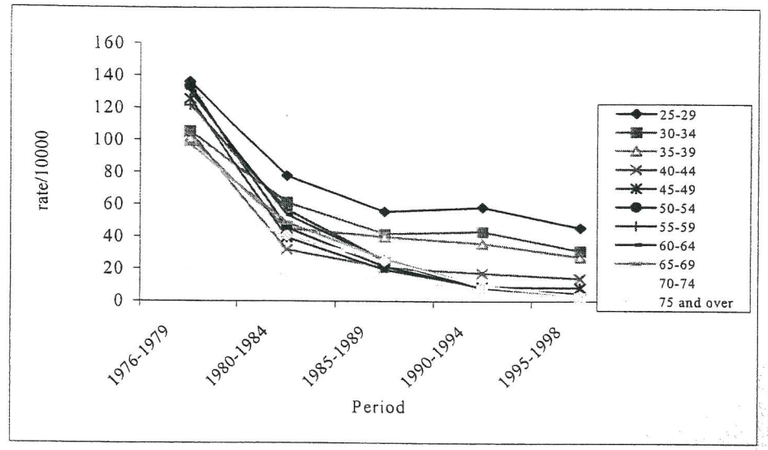


Figure 4.9 Incidence rate of psychotropic substances cases aged under 35

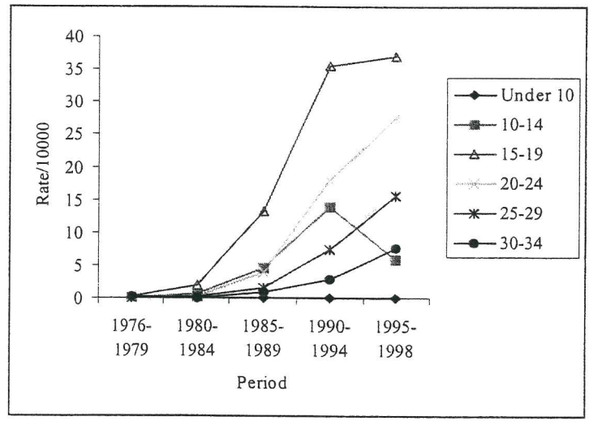
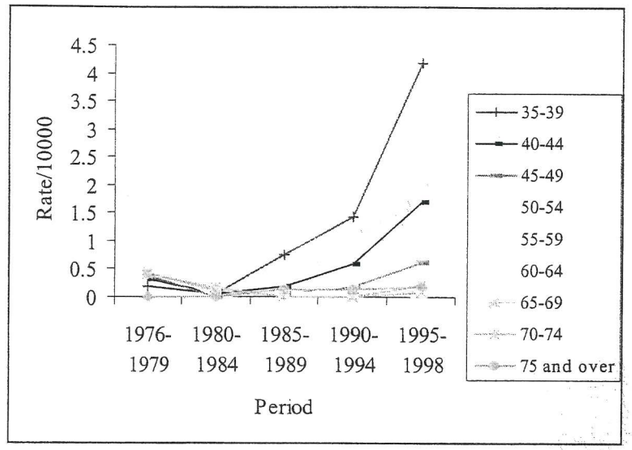


Figure 4.10 Incidence rate of psychotropic substances cases aged 35 and above



4.1.2.10 T The incidence trends were also stratified by gender. The male trends were very similar to those of the overall trends as the males contributed to majority of the reported cases. Hence the results were not detailed here.

4.1.2.11 Among the females, the rises in drug abuse trends were mostly restricted to those aged less than 25 (figure 4.11). The incidence rates among those older than 30 decreased during the study period (figure 4.12).

Figure 4.11 Incidence rate of female aged under 30

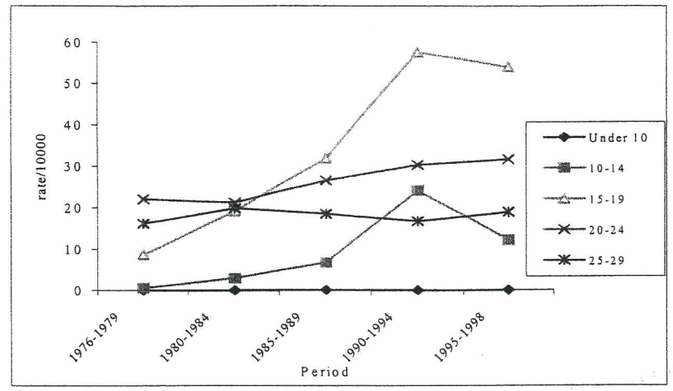
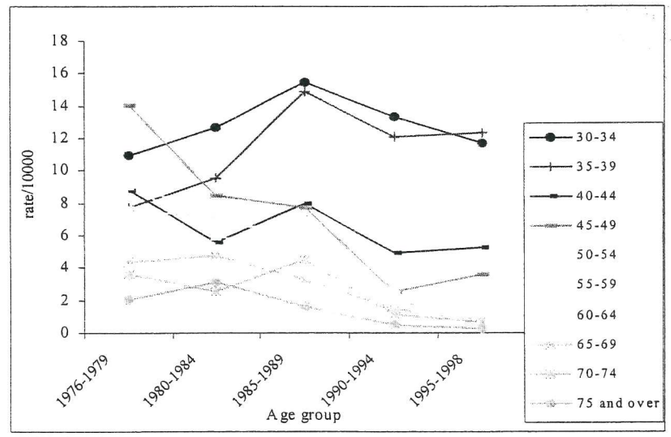


Figure 4.12 Incidence rate of female aged 30 and above



4.2 **Results of Statistical Analysis**

4.2.1 Some potential risk factors are recorded yearly and some are recorded quarterly. Thus, two analyses were attempted for each dependent variable, one using

quarterly data and the other using annual data. When quarterly data do not exist, imputation was performed assuming all 4 quarters have similar distribution.

4.2.2 The potential risk factors that could be examined were:

- Divorce rate
- Inflation rate
- GDP (baseline=1990)
- Rate of offences: juvenile offences (7-15), youth offences (16-20) and adult offences (21 and over)
- Unemployment rate
- Rate of serious narcotics offences
- Major and minor drug offences
- Underemployment rate
- Smoking rates* : youth (15-19) smoking rate and adult (20 and above) smoking rate
- Comprehensives Social Security Assistant Scheme (CSSA) – rate of application in relation to unemployment

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* As there were only 8 data points, interpolation by C++ was adopted.

4.2.3 The detailed results of different modeling will be reported in the appendix1 and 2. A summary of the different modeling results is provided in the following tables.

Keys:

+ve	positive correlation
-ve	negative correlation
@	risk factor becomes insignificant after introducing 1st order autocorrelation
^	1st order autocorrelation
~	scale parameter was estimated by the square root of Pearson's Chi-Squared/DOF.
bolded	concerned risk factors significant in both quarterly statistics and yearly statistics analyses
**	variable regressed on the past outcomes

4.2.4 ***Multiple Regression Model***

4.2.4.1 Time trend is introduced on the incidence rate of psychotropics, for period 1980-1988, time trend=0, time trend for 1989-1997 is expressed as (current year-1988)$^{+}$.

4.2.4.2 Since the data is not random, the significance level is usually chosen to be larger, 0.2 level of significance is adopted in this study, when choosing the covariates. The theory behind is elaborated in a series of papers by Professor Sander Greenland of UCLA and his co-authors. More details can be found in, say, Maldonado, G. and Greenland, S. (1993). (Simulation Study of Confounder-Selection Strategies. American Journal of Epidemiology, 138; 923-936).

4.2.4.3 When the residuals are studied using normal probability plot, the residuals are normal.

4.2.4.4 In most cases, forward and stepwise procedures are adopted and hence the multicollinearity is reduced. Multicollinearity test is included in each regression models, and no significant multicollinearity is found.

Table 4.1 Quarterly statistics

Risk factors	New case^	new female ^	new psychotropics^
Time trend			+ve
Divorce rate			
Inflation rate			
Per capita GDP			
Rate of juvenile (7-15) offences	+ve@		
Rate of young (16-20) offences		+ve	+ve
Rate of adult (21+) offences		+ve@	
unemployment rate	+ve@		
Rate of serious narcotics offences			+ve
Youth smoking rate (male)			
Youth smoking rate (female)		-ve@	
Total smoking rate (male)			
Total smoking rate (female)			
CSSA – unemployment rate		+ve	

Table 4.2 Yearly statistics

Risk factors	new case^	new female	new psychotropics
Time trend			+ve
Divorce rate		+ve	
Inflation rate			
Per capita GDP			
Rate of juvenile (7-15) offences			
Rate of young (16-20) offences			+ve
Rate of adult (21+) offences		+ve	
Unemployment rate	+ve		
Rate of serious narcotics offences			
Youth smoking rate (male)			
Youth smoking rate (female)		-ve	+ve
Total smoking rate (male)			
Total smoking rate (female)			
CSSA - unemployment rate			

4.2.5 **Poisson Regression Model**

4.2.5.1 Overdispersion is observed in each model. The overdispersion means that the data is heterogeneous. In fact, overdispersion is introduced to express this fact. The significance test of the effect of the covariance has taken this into account.

Table 4.3 Quarterly statistics

Risk factors	**Total case~**	**new case~****	**new female ~****	**new psychotropics~****
Divorce rate				-ve
Inflation rate				
Per capita GDP			-ve	
Rate of juvenile (7-15) offences				-ve
Rate of young (16-20) offences			+ve	
Rate of adult (21+) offences	+ve			
Unemployment rate		+ve		
Rate of serious narcotics offences				
Youth smoking rate (male)	-ve	+ve		
Youth smoking rate (female)				**+ve**
Total smoking rate (male)				**-ve**
Total smoking rate (female)	+ve			
CSSA rate -- unemployment		-ve	**+ve**	

Table 4.4 Yearly statistics

Risk factors	Total case**	new case**	new female **	new psychotropics
Divorce rate				-ve
Inflation rate				
Per capita GDP	-ve			
Rate of juvenile (7-15) offences				
Rate of young (16-20) offences			+ve	+ve
Rate of adult (21+) offences				
Unemployment rate	+ve			
Rate of serious narcotics offences				
Youth smoking rate (male)				
Youth smoking rate (female)				**+ve**
Total smoking rate (male)			+ve	**-ve**
Total smoking rate (female)				
CSSA - unemployment rate			**+ve**	+ve

4.2.6 ***Factors are significant in both multiple regression and Poisson regression models***

Table 4.5 Combined table

Risk factors	new case	new female	new psychotropics
Divorce rate			
Inflation rate			
Per capita GDP			
Rate of juvenile (7-15) offences			
Rate of young (16-20) offences		+ve	+ve
Rate of adult (21+) offences			
Unemployment rate	+ve		
Rate of serious narcotics offences			
Youth smoking rate (male)			
Youth smoking rate (female)			+ve
Total smoking rate (male)			
Total smoking rate (female)			
CSSA - unemployment rate		+ve	

4.2.7 A predictive model has been proposed in the study protocol, and the research team has attempted to establish a predictive model. However, such attempts were not successful and no useful model can be established to help future prediction.

5 Discussions

5.1 Overall Trend

5.1.1 The in-depth trend analysis confirms three dominant trends of drug abuse in Hong Kong: juvenilization, feminization, and increased incidence of psychotropic substance abuse. These trends have attracted a lot of attention and discussion in past few years, and are known to professionals and lay people alike. While these trends are generally regarded as relatively new phenomena, our analysis shows that they are not. In fact, it is important to appreciate that these trends began as early as the first half of 1980s, and they betrayed the fall in incidences in late 1980s. As these three major trends have persisted for the past 20 years, they are likely to be driven by major and fundamental forces within Hong Kong society.

5.1.2 It is observed that nearly all drug abuse trends reversed after the peak in 1995. Such reversals are particularly notable among those aged between 10 and 14. The only exception was the psychotropic substance abuse trend, which betrayed this global pattern. Hence, whatever has curbed the drug abuse trend in late 1990s was not applicable to psychotropic substance abuse.

5.2 Regression Analysis

5.2.1 Despite repeated attempts to establish statistical models that best describe the rise and fall of drug abuse trends over the past two decades, the research team cannot arrive at any satisfactory models. As presented in the results section, different modeling techniques (e.g. multiple regression vs. Poisson regression) and different time frames (quarterly vs. yearly) lead to different pattern of significant factors. Besides, no unified themes can be identified from the statistical findings. What's more, what is being presented in this report is merely the simplified version of a more complicated analysis. Shall the results of other analysis, such as survival analysis, are presented; the findings would be more confusing.

5.2.2 Hence, this study does not identify prominent factor that explains the fluctuation of drug abuse trend. And, these can be due to two reasons. Firstly, this study only covers factors that are readily quantifiable. Besides, factors where reliable statistics are not available were not examined. Hence, the scope of investigation is by no means exhaustive.

5.2.3 Second, it is possible that drug abuse trends are not determined by a few prominent factors. Rather the trends may be driven by a great number of factors,

each of which contributes an additive effect to the overall trend and they are all confounded together. If this hypothesis is true, it would be difficult to model the drug abuse trends using regressive statistical techniques on CRDA type data.

5.2.4 The inferential analysis shows that low unemployment rate (both reflect economic prosperity) is associated with lower overall incidence of substance abuse. The associations were significant in both multiple regression and Poisson regression models. Unemployment also appears to have an effect on the overall prevalence rate.

5.2.5 The association between unemployment and drug abuse is also reported by studies, which examined risk factors at individual level. Individuals who abuse drugs tend to have higher rates of unemployment compared with those who do not. The relationship is not necessarily causative though. At an individual level, unemployment can be both the cause and the effect of drug abuse. At a societal level, higher unemployment rate and higher drug abuse incidence may both be the results of rapid industrialization and profound socio-economic transformation, which are witnessed in many Asian countries. Alternately, it has also been argued that it is westernization and globalization that cause

unemployment and drug problems. Based on this theory, as the world becomes more homogenous and Asian societies become more westernized, drug abuse problems and unemployment in Asian societies will eventually reach the level witnessed by most developed countries.

5.2.6 This study was not designed to test these hypotheses. Rather the study was set out to identify macroscopic factors associated with fluctuations of drug abuse trends. Further researches, both empirical and theoretical, are thus needed to dissect the associations.

5.3 Female and Psychotropic Drug Abuse Trends

5.3.1 The regression analyses for female and psychotropic drug abuse trend do not yield any stable statistical models. The association between unemployment social security and female drug abuse trend may relate to the association between unemployment and drug abuse.

5.3.2 Youth offence rate is positively associated with female and psychotropic drug abuse trends. This relationship is likely to be confounding rather than causative. The youth offence rate probably reflects the size of deviant activities among youth population in the society. As most female and psychotropic drug abusers

were youth and young adults, in a broader sense, youth offence and female/psychotropic drug abuse are two sides of the same coin.

5.3.3 Although the analysis shows that female youth smoking rate is associated with psychotropic drug abuse trend, this finding must be interpreted with caution. We found that there were several conflicting findings in relation to smoking rates. This is probably because most data points for smoking rate, especially quarterly data, were imputed. Hence, there is a substantial risk that significant associations with any smoking rates are due to chance association.

5.4 Limitations

5.4.1 Before ending the discussion, it is important to mention the limitations of this study. Firstly, the analysis was thus conducted using only one kind of trend indicator, as only one longitudinal measure of drug abuse problem is available locally. Thus it is not possible to confirm or to refute the modeling using another drug abuse trend indicator. Shall such indicator exist; the analyses would be more robust.

5.4.2 Secondly, as discussed before, not all socio-economic factors under investigation have quarterly statistics. Imputation was thus needed. Such difficulty is particularly notable for smoking statistics. As it is difficult to judge

the likely seasonal effects, the latter was not taken into consideration in the imputation. Such may prevent some significant factors from being identified in the analysis.

5.4.3 Thirdly, it is important to appreciate that significant association does not signify causation. While some of the significant factors, such as smoking and unemployment rate, are scientifically plausible as causative factors, only an experimental design can definitely confirm the hypothesis. The possibility of a third confounding factor should not be forgotten. Hence, that the findings must be interpreted with caution and should never be overstated.

5.4.4 We should emphasis that the data has its own limitation. The first thing is that the data provided by CRDA are in lack of personal level data except the most basic demographic variables and some other minimal information about the drug-takers. The aggregate level variables that we are using are not easily available---for example, the Gini index is available for the census years only. Many factors are all confounded in this kind of data since no design of experiment was involved. If we want to study the effect of unemployment on drug abuse, say, we need to collect the individual level data longitudinally---a kind of panel study. The data we have are in aggregate level. The well-know

fact is even we have the effect of unemployment "significant" at the aggregate level, we still cannot conclude the relationship holds in the individual level. In other words, we should be careful about the ecologic bias---French sociologist Durkheim found the discrepancy between the results in aggregate level and individual level when he analyzed the suicide data. Quite closely related to drug data, the crime data collected by registry also suffered from the same problem.

5.4.5 At last but not the least, we should not overdrive the data. We should admit that since no satisfactory model could be built upon such data, we did try to look for some international journals and books for similar situation. To our disappointment, no results in this aspect have been found on drug abuse. The data provided here is just for the smoothing of the data trend. As an exploratory study, some factors such as unemployment rates, rates of juvenile offences are found to be associated with the incidence.

5.4.6 The Poisson regression model has a moderately over-dispersion, suggesting that underlying assumption was not maintained.

6 Conclusions

6.1 The three major trends of drug abuse (juvenilization, feminization and increased incidence of psychotropic substance abuse) are confirmed in the analysis. These trends, however, are not recent phenomena, and are dated as early as 1980s. Persistent and fundamental psychosocial, economic and cultural forces are likely to be responsible for these stable trends.

6.2 Several social and economic factors are found to be associated with specific drug abuse trends. Unemployment and youth crime rate appear to be more prominent among all examined factors. However, no unified theme can be extracted from these findings, and no single statistical model can be established to account for the trends of drug abuse.

6.3 The study findings indicate that unemployment and criminal offences are associated with drug use and abuse behaviour *at individual level*. However, statistical association does not necessarily equate causation, and more studies are needed to examine the identified relationship. One important follow-up study would be to approach drug-abusing individuals to enquire and to clarify the meanings behind these findings. In-depth qualitative data (especially well conducted ethnography) on contemporary and young Chinese drug abusers are conspicuously lacking, and more studies are needed. Such data will help us

understand what it means to be unemployed in the local modern Chinese context. At public health and policy level, such data may inform us as to how the associations between drug abuse and unemployment can be uncoupled.

7 Appendix

7.1 Appendix 1 Risk Factors of the Analyses

7.1.1 *Autoregressive Analysis and Multiple Regression*

All risk factors listed are significant at 0.2 level of significance in simple regression on each incidence rate.

Quarterly Data Set

Overall incidence rate

Rate of juvenile offences (-ve)

Minor drug offences (+ve)

Unemployment rate (+ve)

Rate of serious narcotics offences (-ve)

Underemployment rate (+ve)

Youth smoking rate (total) (-ve)

Youth smoking rate (male) (-ve)

Youth smoking rate (female) (-ve)

Female smoking rate (+ve)

CSSA (+ve)

Female incidence rate

Divorce rate (+ve)

Inflation rate (-ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of Adult offences (+ve)

Minor drug offences (+ve)

Rate of serious narcotic offences (+ve)

Underemployment rate (+ve)

Youth smoking rate (male) (+ve)

Youth smoking rate (female) (+ve)

Total smoking rate (-ve)

Female smoking rate (-ve)

Male smoking rate (-ve)

CSSA (+ve)

GDP (+ve)

Psychotropic substance incidence rate

Time trend (+ve)

Unemployment rate (-ve)

Underemployment rate (+ve)

Divorce rate (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of adult offences (+ve)

Minor drug offences (+ve)

Rate of serious narcotic offences (+ve)

Youth smoking rate (total) (+ve)

Youth smoking rate (female) (+ve)

Total smoking rate (-ve)

Male smoking rate (-ve)

Female smoking rate (-ve)

CSSA (+ve)

GDP (+ve)

Yearly Data Set

Overall incidence rate

Unemployment rate (+ve)

Underemployment rate (+ve)

Youth smoking rate (total) (-ve)

Minor drug offences (+ve)

Female incidence rate

Rate of serious narcotic offences (+ve)

Under employment rate (+ve)

Youth smoking rate (female) (+ve)

CSSA (+ve)

Divorce rate (+ve)

GDP (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of adult offences (+ve)

Minor drug offences (+ve)

Psychotropic substance incidence rate

Time trend (+ve)

Underemployment rate (+ve)

Divorce rate (+ve)

Rate of serious narcotic offences (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Youth smoking rate (female) (+ve)

Minor drug offences (+ve)

GDP (+ve)

CSSA (+ve)

7.1.2 *Poisson Regression*

All risk factors listed are significant at 0.2 level of significance in simple Poisson regression on each incidence rate.

Quarterly data set

Overall incidence rate

CSSA (+ve)

Unemployment rate (+ve)

Underemployment rate (+ve)

Youth smoking rate (Total) (-ve)

Youth smoking rate (Male) (-ve)

Youth smoking rate (Female) (-ve)

Female smoking rate (+ve)

Rate of serious narcotics offences (-ve)

Minor drug offence (+ve)

Rate of juvenile offences (-ve)

Rate of adult offences (+ve)

Female incidence rate

CSSA (+ve)

Divorce rate (+ve)

Inflation rate (-ve)

Underemployment rate (+ve)

Youth smoking rate (Male) (-ve)

Youth smoking rate (Female) (+ve)

Total smoking rate (-ve)

Male smoking rate (-ve)

Female smoking rate (-ve)

Rate of serious narcotics offences (+ve)

Minor drug offences (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of adult offences (+ve)

GDP (+ve)

Psychotropic substance incidence rate

Time trend (+ve)

CSSA (+ve)

Divorce (+ve)

Unemployment rate (-ve)

Underemployment rate (+ve)

Youth smoking rate (Female) (+ve)

Total smoking rate (-ve)

Male smoking rate (-ve)

Female smoking rate (-ve)

Rate of serious narcotics offences (-ve)

Minor drug offences (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of adult offences (+ve)

GDP (+ve)

Yearly data set

Overall incidence rate

Unemployment (+ve)

Underemployment rate (+ve)

Total smoking rate (-ve)

Minor drug offence (+ve)

Female incidence rate

CSSA (+ve)

Divorce rate (+ve)

Underemployment rate (+ve)

Youth smoking rate (Female) (+ve)

Rate of serious narcotics offences (+ve)

Minor drug offences (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of adult offences (+ve)

GDP (+ve)

Psychotropic substance incidence rate

Time trend (+ve)

CSSA (+ve)

Divorce rate (+ve)

Underemployment rate (+ve)

Youth smoking rate (female) (+ve)

Rate of serious narcotics offences (+ve)

Minor drug offences (+ve)

Rate of juvenile offences (+ve)

Rate of young offences (+ve)

Rate of adult offences (+ve)

GDP (+ve)

7.2 Appendix 2. Results of Additional Analyses

7.2.1 Results of smoking rate among school surveys

We have only two time point data available, namely, year 1992 and year 1996, for the smoking rate. What we can is to (i) compare the trend across two time points and (ii) look at the age specific rates at each time point. Regarding the time trend, we find that most ages, the trends are measured differently in school survey and CRDA data. (4 types: Chinese secondary school, international school, technical institution (full-time) and technical institution (part-time).

7.2.2 **Results of transfer function**

We study the time lag through transfer function model. The term transfer function model refers to a model that predicts dependent variable y_t (called the output series) on the basis of past values of explanatory variables x_t (called the input series)

In transfer function framework, a three-step procedure for building a transfer function model is followed. We first study the time lag structure of the input and output series in the first two steps and then, finally, study the time lag structure in the prediction model.

(A) Identifying a time series model to describe the input series

Table 7.1 shows the identified model of the input series. As white noise is just noise and no further time lag structure to be explored, those variables shows white noise pattern in our analysis will be excluded in the following procedure.

Table 7.1

Quarterly data		**AR**	**MA**	
Explanation variables	**Period of differencing**	**P**	**Q**	**Remarks**
Divorce rate	8	1		
Inflation rate	1			White noise
Unemployment	1			White noise
Rate of narcotics offences	1			White noise
Rate of juvenile offences	1,4	(4)		No constant term
Rate of young offences	1			White noise
Rate of adult offences	1		(4)	
Youth smoking rate (female)	1	3	2	AR terms (2,3) are not significant
Youth smoking rate (male)	1,4	3		
Youth smoking rate (total)	1	2		
Female smoking rate	1	2	(2)(4)	
GDP	4	1	1	
CSSA-unemployment	1	1		No constant term

(B) Identifying a preliminary transfer function model describing the output series

(a) Overall incidence rate is white noise after applying first period differencing† and no cross-correlation is significant among total number of reported cases and other explanatory variables.

(b) Female incidence rate having first period differencing and is modeled by AR (1) process

(c) Psychotropic substance incidence rate having first period differencing and is modeled by AR (1) process

(C) Using the residual for the preliminary model to identify a model describing the error structure of the preliminary model and to form a final transfer function model

(a) The time lag pattern among explanatory variables on the output series is shown in the cross-correlation function

(b) The time lag is determined empirically by the data themselves

(c) For the female incidence rate, we found that it related to its first order autoregressive term and rate of adult offences at lag 3. The psychotropic substance incidence rate, is related to its first order autoregressive term and rate of young offence at lag 7

7.2.3 **Results of selected social indicators**

The indicator is available for only 6 time points at most. It seems that we can provide a plot to see the trend. (and correlation coefficient)

1. Male and female adult smoking rate per 100000 population aged 20 and above
2. Male and female labour force participation rate (LFPR)
3. Male and female unemployment rate
4. Incidence of long term unemployment (3+ months) per 100000 in labour force
5. Percentage of (male and female) employees earning less than half of the median income
6. Gini coefficient
7. School dropout rate (in percentage)

There is no significant result found in the correlation analysis of the selected indicators and CRDA drug abuse rates.

[†] First period differencing is often applied to nonstationary time series