RESEARCH ARTICLE

Trends in the Incidence of 15 Common Cancers in Hong Kong, 1983-2008

Wen-Chuan Xie[1], Man-Him Chan[2], Kei-Choi Mak[3], Wai-Tin Chan[4], Miao He[1]*

Abstract

Background: The objective of this study WAS to describe cancer incidence rates and trends among THE Hong Kong population for the period 1983-2008. Methods: Incident cases and population data from 1983 to 2008 were obtained from the Hong Kong Cancer Registry and the Census and Statistics Department, respectively. Age-standardized incidence rates (ASIR) were estimated and joinpoint regression was applied to detect significant changes in cancer morbidity. Results: For all cancers combined, the ASIR showed declining trends (1.37% in men, 0.94% in women), this also being the case for cancers of lung, liver, nasopharynx, stomach, bladder, oesophagus for both genders and cervix cancer for women. With cancer of thyroid, prostate, male colorectal, corpus uteri, ovary and female breast cancer an increase was evident throughout the period. The incidence for leukemia showed a stable trend since early 1990s, following an earlier decrease. Conclusions: Although overall cancer incidence rates and certain cancers showed declining trends, incidence trends for colorectal, thyroid and sex-related cancers continue to rise. These trends in cancer morbidity can be used as an important resource to plan and develop effective programs aimed at the control and prevention of the spread of cancer amongst the Hong Kong population. It is particularly useful in allowing projection of future burdens on the society with the increase in certain cancer incidences.

Keywords: Cancer - time trends - joinpoint analysis - age-standardized incidence rates - Hong Kong

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Introduction

Cancer is an eminent health problem, worldwide. Research published in 2010 estimated that, globally, there was 12.7 million new cases in 2008, and the burden of cancer increased as a result of population aging and changes in lifestyle (tobacco and alcohol consumption, nutritional habits, physical activity) that added to those pre-existing risk factors (especially cancer-related infections) (Ferlay et al., 2010). In Hong Kong, approximately 30% of death due to cancer was of extreme concern during 1981-2008 (Centre for Health Protection, 2012). Investigation has shown that the number of new cases of cancer was increasing at a rate of 2% per annum (Law et al., 2007). There were 24 635 new cases (ratio of male to female, 13 139: 11 496) in Hong Kong in 2008, and the top five prevalent cancers were cancers of lung, colorectal, breast, liver and prostate (Hong Kong Cancer Registry, 2012).

With the rapid economic growth and the remarkable development of Hong Kong from a small fishing village into a cosmopolitan metropolitan city, the life-style of most citizens changed substantially. With the technological progress, the related morbidity might also have changed. Although there were some case-control studies and epidemiology investigates of cancer morbidity or mortality; however, they were carried out only for a certain cancer, and used only short-term data or the data was out of date (Leung et al., 2002; Lee et al., 2003; Au et al., 2004; Ho et al., 2004; Tse et al., 2007; Yee et al., 2007; Yee et al., 2010). In order to monitor recent rates and a long-term trend in cancer incidence among the Hong Kong population, we had analyzed the occurrence of cancer morbidity during the span of time from 1983 to 2008 with the use of data from Hong Kong Cancer Registry.

The Hong Kong Cancer Registry was established in 1963 as a population-based cancer registry, and is a member of the International Agency for Research on Cancer (IARC). This registry had access to almost all hospital/laboratory cancer data in both private and public sectors in the territory. It contained a series of comprehensive cross-checking programs to ensure data were highly accurate. First, they were meticulously checked to eliminate duplications by using the Hong Kong Identity Card Number, together with each patient's name and date of birth. Validity of the data was further tested for the combinations of compatibilities of site-gender, site-age and site-pathology. The source of data was documented and histological confirmation traced as far as possible. Original records were checked in case of doubt.

*[1]Bioinformatics, School of Life Sciences, Sun Yat-sen University, Guangzhou, [3]BEEXergy Consulting Ltd, Hong Kong, [4]Research Centre of Built Environment and Energy Conservation, Institute for Advanced Study, Nanchang University, Nangchang, China, [2]Welsh School of Architecture, University of Wales, College of Cardiff , Cardiff, UK *For correspondence: lsshem@mail.sysu.edu.cn*

Materials and Methods

The number of morbidity by cancer sites, stratified for gender and 5-year age group for cancer for the period 1983-2008, were derived from vital statistics compiled by the Hong Kong Cancer Registry (Hong Kong Cancer Registry, 2012). Population figures were obtained from census data and inter-census estimates, by calendar year, age and gender. Population censuses of Hong Kong were to be conducted in every 10 years and by-census was held between two census by the Census and Statistics Department (C&SD) (Census and Statistics Department, 2012).

During 1983-2008, two different revisions of the International Classification of Disease (ICD) were used. In Hong Kong, this included ICD-9 from 1983 to 2000 and ICD-10 for 2000 onward (World et al., 1992). Since the differences were minor in various revisions, we recorded cancer sites for analysis included the 15 major cancers: nasopharynx (NPC) (C11), oesophagus (C15), stomach (C16), colorectum (CRC) (C18-21), liver (C22), lung (C33-34), female breast (C50), cervix (C53), corpus uteri (C54), ovary (C56), prostate (C61), bladder (C67), thyroid (C73), non-hodgkin's lymphoma (NHL) (C82-85), and leukemia (C91-95). Age-standardized incidence rates (ASIR) per 100,000 population per year were calculated for all cancers combined stratified classification by gender using the WHO world standard population (Ahmad et al., 2000). A long-term trend in ASIR was analyzed using the Joinpoint regression model (Kim et al., 2000), which change in the annual ASIR was examined by calculating the average annual percent change (APC) and the corresponding 95% confidence interval. This method described changes in data trends by connecting several different line segments on a log scale at 'joinpoints.' Tests of significance used a Monte Carlo permutation method. Joinpoint software 3.5.2 from the Surveillance Research Program of the US National Cancer Institute was used for trend analysis (National Cancer Institute, 2012), which analysis commenced with zero joinpoints and tests for model fitted with a maximum of five joinpoints.

Table 1. Incidence of Ten Leading Cancers Between Different Genders (1983-2008)

	Male			Female	
Lung	64 180	23.18%	18.43%	40 755	Breast
CRC[a]	38 742	13.99%	14.45%	31 973	CRC[a]
Liver	31 428	11.35%	14.06%	31 104	Lung
NPC[b]	20 060	7.25%	5.44%	12 037	Cervix
Stomach	16 014	5.78%	4.33%	9 576	Stomach
Prostate	13 362	4.93%	4.20%	9 292	Liver
Bladder	11 092	4.01%	3.74%	8 274	Corpus uteri
Oesophagus	10 909	3.94%	3.53%	7 799	Ovary
NHL[c]	7 761	2.80%	3.40%	7 519	NPC[b]
Leukaemia	5 398	1.95%	3.31%	7 313	Thyroid
All sites	276 871	100%	100%	221 193	All sites

[a]CRC, colorectum cancer; [b]NPC, nasopharynx cancer; [c]NHL, non-hodgkin's lymphoma

Results

Table 1 listed the incidence of ten leading cancers between different genders in Hong Kong from 1983 to 2008. Lung cancer was the leading morbidity in men during the study period, which accounted for 23.18% for the overall cancer incidence cases. With women, breast cancer made up to 18.43% of the cases of all cancers combined. The trend of ASIR for all sites combined in males and females are presented in Figure 1. As for males, the ASIR of overall cancers showed significant decreased by 1.37% per year during the study period. Among females, the ASIR decreased significantly by 0.94% per year until 2003 and then leveled off thereafter.

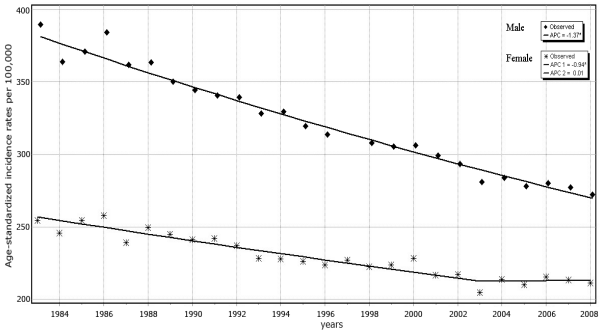

Figure 1. 'Best' Joinpoint Model Estimates for all Sites Combined in Hong Kong, 1983-2008

Table 2. Trend in Cancer Morbidity Per 100 000 Men by All Cancers Combined and Major Cancers in Hong Kong for 1983-2008

Cancer Sites	ASIR[a]	ASIR	Trend 1			Trend 2			Trend 3		
	1983	2008	Year	APC[b]	95%CI[c]	Year	APC	95%CI	Year	APC	95%CI
All sites	389.8	272	1983-2008	-1.37*	-1.5, -1.3						
Lung	94.62	55.76	1983-2008	-2.08*	-2.3, -1.9						
Liver	46.3	35.61	1983-1993	-1.02	-2.2, 0.2	1993-2008	-2.45*	-2.9, -2.0			
CRC	38.38	45.63	1983-2008	0.78*	0.6, 1.0						
NPC	35.61	14.91	1983-2000	-2.81*	-3.2, -2.5	2000-2003	-7.26	-14.4, 0.4	2003-2008	-1.25	-2.9,0.4
Stomach	27.06	13.11	1983-2008	-2.86*	-3.1, -2.6						
Oesophagus	21.06	7.46	1983-2008	-4.37*	-4.7, -4.1						
Bladder	18.78	5.48	1983-2002	-2.22*	-3.1, -1.3	2002-2008	-11.23*	-13.8, -2.5			
NHL	8.03	8.53	1983-1986	7.46	-3.1, 19.1	1986-2008	-0.87*	-1.2, -0.5			
Thyroid	1.2	2.49	1983-2008	1.97*	1.2, 2.8						
Leukaemia	7.84	5.94	1983-1993	-3.7*	-6.2, -1.1	1993-2008	0.48	-0.7, 1.7			
Prostate	10.28	27.09	1983-1995	0.48	-1.5, 2.5	1995-1999	14.55*	4.1, 26.1	1999-2008	4.59*	3.2, 6.0

*statistically significant compared to zero ($p<0.05$); [a]ASIR, Age-standardized incidence rates (per 100 000); [b]APC, Annual Percentage Change; [c]95%CI, 95% Confidence Interval

Table 3. Trend in Cancer Morbidity Per 100 000 Women by All Cancers Combined and Major Cancers in Hong Kong for 1983-2008

Cancer Sites	ASIR[a]	ASIR	Trend 1			Trend 2			Trend 3		
	1983	2008	Year	APC[b]	95%CI[c]	Year	APC	95%CI	Year	APC	95%CI
All sites	254.4	211.4	1983-2003	-0.94*	-1.1, -0.8	2003-2008	0.01	-0.8,0.8			
Lung	35.76	24.46	1983-1993	-0.8	-1.9, 0.3	1993-1996	-6.41	-16.2, 5.2	1996-2008	-1.39*	-1.9, -0.9
Liver	12.27	7.59	1983-1996	-0.04	-1.3, 1.2	1996-2001	-6.60*	-11.7, -1.2	2001-2008	-0.2	-2.1, 1.8
CRC	29.98	30.37	1983-1994	1.33*	0.5, 2.2	1994-2008	-0.67*	-1.1, -0.3			
NPC	12.62	4.79	1983-1997	-2.82*	-3.8, -1.8	1997-2008	-5.43*	-6.6, -4.2			
Stomach	13.34	6.68	1983-2008	-2.93*	-3.2, -2.6						
Oesophagus	4.47	1.45	1983-2008	-4.46*	-5.0, -3.9						
Bladder	5.4	1.31	1983-2003	-3.38*	-4.1, -2.6	2003-2008	-15.36*	-18.7, -11.9			
NHL	5.66	5.41	1983-2008	-0.57*	-1.1, -0.1						
Thyroid	5.31	10.61	1983-1989	6.49*	2.3, 10.9	1989-2004	0.01	-0.8, 0.9	2004-2008	7.31*	2.7, 12.1
Leukaemia	6.91	4.62	1983-1989	-6.56*	-11.4, -1.5	1989-2008	-0.39	-1.2, 0.4			
Breast	35.65	49.97	1983-2008	1.77*	1.6, 2.0						
Cervix	24.73	6.89	1983-2008	-4.40*	-4.8, -4.0						
Corpus uteri	6.61	12.36	1983-1994	0.48	-1.2, 2.2	1994-2008	3.32*	2.5, 4.1			
Ovary	7.97	9.25	1983-2008	0.87*	0.6, 1.2						

*: statistically significant compared to zero (p<0.05). [a]ASIR: Age-standardized incidence rates (per 100 000). [b]APC: Annual Percentage Change. [c]95%CI: 95% Confidence Interval

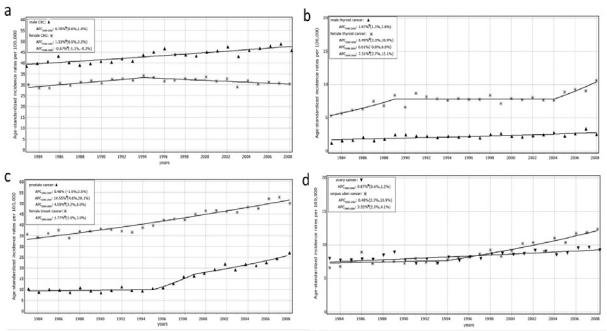

Figure 2. Observed Standardized (Per 100,000 World Standard) Rates and 'Best' Joinpoint Model Estimates for Cancers that Showed Increased Trend in Hong Kong, 1983-2008. (a) colorectum cancer; (b) Thyroid cancer; (c) prostate cancer and female breast cancer; (d) Corpus uteri cancer and Ovary cancer

Table 2 and 3 listed the results of the Joinpoint analyses by gender and cancer site, applied to morbidity rates from 1983 to 2008. Trends for CRC, thyroid, prostate, female breast, uterine, and ovary cancers are depicted in Figure 2. With males, the ASIR for lung cancer decreased significantly by 2.08% per year in the study period. As for females, lung cancer became third in morbidity, following breast and colorectum cancer. ASIR of lung cancer showed significant decreased of 1.39% per year since 1996.

Colorectal cancer was the second most frequent cancer for both men and women. With males, ASIR for CRC showed an increasing trend with approximately 0.8% per annum from 1983 to 2008. As for females, ASIR of CRC showed a steady decrease from 1994 to 2008, following the significant increased observed previously by 1.33% per annum.

Liver cancer was ranked third for males and sixth for females throughout the entire 26-year period. With males, ASIR of liver cancer leveled off until 1993, and began to decrease by 2.45% per annum from 1993 to 2008. As for females, ASIR of liver cancer leveled off from 1983 to 1996, and began with a remarkable decreasing trend with 6.6% per annum from 1996 to 2001, and then leveled off from 2001 onwards.

ASIR of nasopharynx cancer decreased significantly by 3.5% per annum for men and 5.4% per year for women during the previous ten years.

There was a significant decreased in cases for stomach and oesophagus cancer, which ASIR for stomach cancer showed a decreasing rate of 2.86% and 2.93% per annum since 1983 for males and females, respectively. With oesophagus cancer, the rates decreased significantly by 4.37% and 4.46% per year from 1986 to 2008 for men and women, respectively.

ASIR for bladder cancer decreased during the study period, with an astonishing decreasing rate of 11.23% and 15.36% per annum since 2003 for men and women, respectively. There was a leveling off of morbidity rates for non-hodgkin's lymphoma since 1986.

Morbidity rates from thyroid cancer remained low for men (2.49/100 000 in 2008). However, there was a significant change in ASIR during the observation period (APC: 1.97%; 95%CI: 1.2%, 2.8%). With females, ASIR of thyroid cancer increased from 1983 to 1989, leveled off from 1989 to 2004, and increased significantly by 7.31% per annum since 2004.

ASIR of leukemia showed a decreasing trend of 3.7% and 6.56% per annum until the end of 1990s for males and females, respectively; and then ASIR of leukemia leveled off afterwards.

Prior of 1995, ASIR of prostate cancer showed a steady level, and then began to increase significantly. ASIR increased by 4.6% per annum during the last 10 years. As for females, ASIR of cancer of breast, corpus uteri, ovary showed increasing trend. There were increasing rates of 1.8% per annum for breast cancer, 3.3% per annum for corpus uteri and 0.9% per annum for ovary cancer in the last 10 years. In contrast, ASIR of cervix cancer decreased 4.4% per annum during the last 26-year time period.

Discussion

Understanding cancer trends is momentous in

cancer control monitoring and are also used to carry out evaluation for changes in cancer risk, cancer screening programs, and effectiveness of health care (Wingo et al., 2003). This study has presented detailed analysis on the trends of cancer morbidity rates in Hong Kong during 1983-2008. Decline trends in morbidity rates of most types of cancer were observed in the whole study period and were identified for both genders. The over decline for the morbidity rates in recent two decades is mostly attributable to reduce cancers for lung, liver, nasopharynx, stomach, bladder, oesophagus, NHL, leukemia for both genders and cervix cancer for women. But in contrast, colorectum cancer, thyroid cancer, female breast cancer, corpus uteri cancer, ovary cancer, prostate cancer showed different trends in the study period.

Lung cancer is the most common cancer for men and ranks third for women. The rates decrease progressively throughout the study period, attributable to the decrease in squamous cell, small cell and large cell carcinoma (Au et al., 2004). Environmental, occupational and socioeconomic factors may be more apparent as etiological factors for lung cancer, and smoking has been consistently established as the main one (Chan-Yeung et al., 2003; Chiu et al., 2004; Wang et al., 2009; Chiu et al., 2010). The trend in morbidity rates has attributed to the effects of the policy of prohibiting smoking by the Government of the Hong Kong Special Administrative Region (HKSAR) since 1983. In 2009, the HKSAR implements the seventh anti-smoking measures in all public facilities in Hong Kong in order to reduce pollutants that could lead to cancer.

Hong Kong is endemic in chronic hepatitis B virus (HBV) infection, which approximately 85% of liver cancer are hepatocellular carcinoma, as HBV is the main causative agent (Law et al., 2007). Perinatal transmission from mother-to-infant, blood transmission, sexual contact and other body fluids contact may play important roles in spreading the infection in the population. The reduction of liver cancer morbidity since mid-1990s is interpreted as an effect of the decreasing prevalence of HBV. In order to control HBV infection in the vast Hong Kong population, a universal neonatal vaccination program had been launched in 1988, which hepatitis B vaccines are provided to all newborns (Kwan et al., 1997). The HBsAg prevalence follows a continual falling trend since early 1990s in Hong Kong, the current HBsAg carriage rate in the local adult population is estimated to be approximately 8% in 1996, and have since declined to 1.8% by the year 2008 (Kwan et al., 1997; Viral Hepatitis Preventive Service, 2012).

NPC is rare in most parts of the world; however it shows high rates among Cantonese in Southern China and Southeast Asia. The highest rate is noted in Hong Kong, with the third highest ASIR record in the world (Ferlay et al., 2012). Therefore, risk factors for NPC have been established to include environmental risk factors (Epstein–Barr virus (EBV) infection and smoking) and non-viral environmental risk factors (consumption of Cantonese-styled salted food and genetic factor) (Yu et al., 2002; Lu et al., 2005). In this study it is observed that there is a sharp declined trend for ASIR for NPC in Hong Kong during the study period. There is a progressive declination primarily to keratinizing tumors, which is consistent with the declining rate in smoking since the mid-1970s for both genders among Hong Kong population (Tse et al., 2006). Furthermore, with rapid economic development and accompanying improvements in early disease detection and in lifestyle in Hong Kong, the gradual reduction of population exposures to environmental risk factors and non-viral environmental risk factors have contributed to the decreasing trend of other subtypes of NPC.

The trend of morbidity rates from oesophagus cancer and stomach cancer have decreased in the previous two decades. Environmental and lifestyle factors are the two major contributors to the etiology of these types of cancers. Changes in environmental risk factors, such as reduced use of salt, improved food conservation, a more affluent diet with increased consumption of fresh fruit and vegetables and avoidance of smoking are considered to have played vital roles in the reduction of the two cancers morbidity and mortality (Crew et al., 2006; Tse et al., 2007). Besides tobacco smoking, heavy alcohol drinking have been recognized as an other main risk factor for esophageal cancer, yet it is unlikely to be materially involved in the etiology of stomach cancer (Franceschi et al., 1994). The prevalence of alcohol-related drinks consumption in Hong Kong is low, approximately 0.8% of the residents drinks ≥ 50 gm/day (Fu et al., 2004). In addition, some epidemiology studies have reported that alcohol has significant associations with H. pylori infection and stomach and esophageal cancer risk, yet it differs by tumor location and histology (Martel et al., 2005; Fock et al., 2010). The declining trend in ASIR is in line with the decreasing number of H. pylori infection with the rapid socio-economic development of Hong Kong in the last few decades.

Bladder cancer, NHL and Leukemia for men are ranked as three of the top ten cancers over the entire period. Smoking is one of the most common triggering factors for bladder cancer, which more than 50% of all male bladder cancer is attributed by cigarette smoking (Jankovic etal., 2007). The etiology of the most common NHL types remains elusive. Environmental, dietary, immunosuppression and infectious agents have been recognized as the main risk factors for NHL (Müller et al., 2005). Although ASIR is rare, leukemia is the most common type of childhood cancer, accounts for 40% of all cancers diagnosed in children younger than 15 years in Hong Kong (Li et al., 1999). Approximately 90% of Leukemia with an unclear etiology, ionizing radiation is recognized as the main environmental risk factor (Belson et al., 2007). The observation in Hong Kong, showing a decrease in risk (ASIR), probably reflected the improvements in living throughout the period.

Morbidity rates of cervix cancer have been declining. Joinpoint analyses demonstrate that ASIR of cervix cancer declined significantly, by 4.4% per annum from 1983 to 2008. The decreasing trend in ASIR may be due to the introduction of Pap smear since 1960s, and as part of antenatal care in the 1980s (Leung et al., 2006).

Meanwhile, some cancers such as male CRC, thyroid, prostate,corpus uteri, ovary and female breast cancers have increased in ASIR, similar to trend observed in Singapore (Lim et al., 2012). Due to the low alcohol consumption and

rigorous tobacco control policies, a possible explanation for the increasing is due to the changes to a westernized lifestyle early in the past century. Public-health strategies that promote modest alcohol consumption, smoking cessation, increased physical activity and intake of vegetables and fruits, implement population-based programme of CRC screening are likely to have significant benefits at the population level for reducing the incidence of CRC in Hong Kong. Breast cancer remain the most important cancer in women, accounting for more than 18% of all female cancers, with significant increasing trends throughout the whole 26-years time period. These trends seemed to be related to change in lifestyle that continuous factors of the factors of the risk of cancer, and certainly to the opportunistic screening in voluntary, self-financed and self-referral basis since the early 1990s of breast cancer among Hong Kong women. Exposure to estrogen, early prematurity, late marriage (27.9 years in Hong Kong in 2000) and delayed menopause may also partly explain the increasing trends of breast cancer (Schmidt et al., 2008).

Our report includes 26 year-period of data, and it is believed that the Figures presented in this study provide a reasonably accurate description of cancer incidence trends and can contribute to a better understanding of cancer incidence patterns in Hong Kong. A declining trend in all cancers combined and in the majority cancers are observed in Hong Kong during the study period. Nevertheless, the aging population and overall increases in risk of cancer have still increased the crude incidence rates and the absolute total number of cancer case. The trend in cancer morbidity can be used as an important resource to plan and develop effective program aiming at the control and prevention of the spread of cancer amongst Hong Kong population. It is particularly useful in allowing projection of future cancer burdens.

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References

Ahmad O, Boschi Pinto C, Lopez A, et al (2000). Age standardization of rates: A new WHO standard. GPE Discussion Paper No. 31.

Au JSK, Mang OWK, Foo W, et al (2004). Time trends of lung cancer incidence by histologic types and smoking prevalence in Hong Kong 1983–2000. *Lung Cancer*, **45**, 143-52.

Belson M, Kingsley B, Holmes A (2007). Risk factors for acute leukemia in children: a review. *Environ Health Persp*, **115**, 138.

Census and Statistics Department, The Government of the Hong Kong Special Administrative Region. Available at http://www.censtatd.gov.hk/home/index.jsp.

Centre for Health Protection, Department of Health, the Government of the Hong Kong Special Administrative Region. Available at http://www.chp.gov.hk/en/index.html.

Chan-Yeung M, Koo L, Ho JCM, et al (2003). Risk factors associated with lung cancer in Hong Kong. *Lung Cancer*, **40**, 131-40.

Chiu YL, Wang XR, Qiu H, et al (2010). Risk factors for lung cancer: a case–control study in Hong Kong women. *Cancer Causes and Control*, **21**, 777-85.

Chiu YL, Yu ITS, Wong TW (2004). Time trends of female lung cancer in Hong Kong: age, period and birth cohort analysis. *Int J Cancer*, **111**, 424-30.

Crew KD, Neugut AI (2006). Epidemiology of gastric cancer. *World J Gastroentero*, **12**, 354.

de Martel C, Llosa AE, Farr SM, et al (2005). Helicobacter pylori infection and the risk of development of esophageal adenocarcinoma. *J Infect Dis*, **191**, 761.

Ferlay J, Heanue M, Boyle P. Cancer Incidence in Five Continents. Vol. IX. IARC Scientific Publication, No. 160.

Ferlay J, Shin HR, Bray F, et al (2010). Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *Int J Cancer*, **127**, 2893-917.

Fock KM, Ang TL (2010). Epidemiology of Helicobacter pylori infection and gastric cancer in Asia. *J Gastroen Hepatol*, **25**, 479-86.

Franceschi S, La Vecchia C (1994). Alcohol and the risk of cancers of the stomach and colon-rectum. *Digestive Dis*, **12**, 276-89.

Fu FH, Fung L (2004). The cardiovascular health of residents in selected metropolitan cities in China. *Prev Med*, **38**, 458-67.

Ho JWC, Lam TH, Tse CW, et al (2004). Smoking, drinking and colorectal cancer in Hong Kong Chinese: A case-control study. *Int J Cancer*, **109**, 587-97.

Hong Kong Cancer Registry, Available at http://www3.ha.org.hk/cancereg/default.asp.

Jankovic S, Radosavljevic V (2007). Risk factors for bladder cancer. *Tumori*, **93**, 4.

Kim HJ, Fay MP, Feuer EJ, et al (2000). Permutation tests for joinpoint regression with applications to cancer rates. *Sta Med*, **19**, 335-51.

Kwan L, Ho Y, Lee S (1997). SHORT PAPER The declining HBsAg carriage rate in pregnant women in Hong Kong. *Epidemiol Infect*, **119**, 281-3.

Law C, Mang O (2007). Cancer incidence in Hong Kong. *Medical Bulletin*, **12**.

Lee AWM, Foo W, Mang O, et al (2003). Changing epidemiology of nasopharyngeal carcinoma in Hong Kong over a 20-year period (1980-99): An encouraging reduction in both incidence and mortality. *Int J Cancer*, **103**, 680-5.

Leung G, Thach T, Lam T, et al (2002). Trends in breast cancer incidence in Hong Kong between 1973 and 1999: an age-period-cohort analysis. *Brit J Cancer*, **87**, 982-8.

Leung GM, Woo PPS, McGhee SM, et al (2006). Age-period-cohort analysis of cervical cancer incidence in Hong Kong from 1972 to 2001 using maximum likelihood and Bayesian methods. *J Epidemiol Commun H*, **60**, 712-20.

Li CK, Mang O, Foo W (1999). Epidemiology of paediatric cancer in Hong Kong, 1982 to 1991. Hong Kong cancer registry. *Hong Kong Med J*, **5**, 128-34.

Lim G, Chow K, Lee H (2012). Singapore cancer trends in the last decade. *Singap Med J*, **53**, 3.

Lu CC, Chen JC, Tsai ST, et al (2005). Nasopharyngeal carcinoma-susceptibility locus is localized to a 132 kb segment containing HLA-A using high-resolution microsatellite mapping. *Int J Cancer*, **115**, 742-6.

Müller AMS, Ihorst G, Mertelsmann R, et al (2005). Epidemiology of non-Hodgkin's lymphoma (NHL): trends, geographic distribution, and etiology. *Ann Hematol*, **84**, 1-12.

National Cancer Institute (2011). Joinpoint regression program, version 3.5.2. Available at http://surveillance.cancer.gov/joinpoint/.

Schmidt ME, Steindorf K, Mutschelknauss E, et al (2008). Physical activity and postmenopausal breast cancer: effect

modification by breast cancer subtypes and effective periods in life. *Cancer Epidemiol Biomarkers Prev*, **17**, 3402-10.
Tse L, Yu IT, Mang OWK (2007). Time trends of esophageal cancer in Hong Kong: Age, period and birth cohort analyses. *Int J Cancer*, **120,** 853-8.
Tse L, Yu ITS, Mang OWK, et al (2006). Incidence rate trends of histological subtypes of nasopharyngeal carcinoma in Hong Kong. *Brit J Cancer*, **95**, 1269-73.
Viral Hepatitis Preventive Service, Department of Health, The Government of the Hong Kong Special Administrative Region. Available at http://www.info.gov.hk/hepatitis/chs/group02_set.htm.
Wang XR, Chiu YL, Qiu H, et al (2009). The roles of smoking and cooking emissions in lung cancer risk among Chinese women in Hong Kong. *Ann Oncol*, **20**, 746.
Wingo PA, Cardinez CJ, Landis SH, et al (2003). Long-term trends in cancer mortality in the United States, 1930–98. *Cancer*, **97**, 3133-275.
World Health Organization (1992). Manual of the international statistical classification of diseases, injuries, and causes of death (Vol. 10th revision). *Geneva, Switzerland: World Health Organization*.
Yee YK, Cheung T, Chan AOO, et al (2007). Decreasing trend of esophageal adenocarcinoma in Hong Kong. *Cancer Epidemiol Biomarkers Pre*, **16**, 2637-40.
Yee YK, Gu Q, Hung I, et al (2010). Trend of colorectal cancer in Hong Kong: 1983-2006. *J Gastroen Hepatol*, **25**, 923-7.
Yu MC, Yuan JM (2002). Epidemiology of nasopharyngeal carcinoma. *Semin Cancer Biol*, 421-9.