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A Jockey Club Initiative for Seniors

Trends of Disease Burden Consequent to Chronic Lung Disease in Older Persons in Hong Kong:

Implications of Population Ageing

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by

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CADENZA: A Jockey Club Initiative for Seniors

CADENZA: A Jockey Club Initiative for Seniors is launched and funded by The Hong Kong Jockey Club Charities Trust in light of the rapidly ageing population. It is a HK$380 million project in partnership with the Faculty of Social Sciences of The University of Hong Kong and the Faculty of Medicine of The Chinese University of Hong Kong. The project aims at creating an elder-friendly environment in Hong Kong to foster positive community attitude towards ageing and continuously improve the quality of care and quality of life of older people.

CADENZA is an acronym for "**C**elebrate their **A**ccomplishments; **D**iscover their **E**ffervescence and **N**ever-ending **Z**est as they **A**ge." In classical music, a "Cadenza" is an extended virtuosic section, usually near the end of a movement in a concerto. The word is used figuratively to describe the apex of one's life and the celebration of a lifetime's accomplishments.

CADENZA has 4 major components:

1. ***Public Education*** is to promote positive ageing and highlight important issues pertaining to the elderly population, covering 6 themes: (i) health promotion and maintenance, (ii) health and social services in Hong Kong, (iii) living environment, (iv) financial and legal issues, (v) quality of life and quality of dying, and (vi) age disparities.
2. ***Community Projects*** are innovative and sustainable service models designed to cope with the changing needs of seniors. One of the innovative projects is the establishment of The Jockey Club CADENZA Hub in Tai Po, which is an integrated primary health and social care centre for the old and the soon-to-be-old.
3. ***Training*** programme offers on-line courses, workshops and public seminars to train different levels of health and social care professionals, front line workers, carers and the general public.
4. ***Leadership Training Programme and Research*** is to nurture academic leadership in gerontology, conduct research to advance gerontological knowledge and evaluate the outcomes of CADENZA programmes.

The findings covered by this report are part of the series "Challenges of population ageing on disease trends and burden" carried out by CADENZA in collaboration with the Department of Community Medicine, the School of Public Health of The University of Hong Kong. This series utilises existing data to estimate the effect of the ageing population on the impact of various chronic diseases on individuals and society as a whole. The current volume of the series focuses on chronic lung disease. This report is made available to the public with the compliments of The Hong Kong Jockey Club Charities Trust.

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Contents

Preface

This report is the fourth in the series examining the impact of the ageing population on Hong Kong society in terms of health and social wellbeing, supported by The Hong Kong Jockey Club CADENZA Project, to promote an elder-friendly environment in a broad sense. The first volume documented current wellbeing of the elderly population in terms of lifestyle, social network and engagement, financial security, functional and health status and health-seeking behaviour, with comparisons with other developed countries (Chau & Woo, 2008). With increasing life expectancy and in parallel onset of chronic diseases associated with ageing, it is pertinent to examine the impact of the ageing population on chronic disease burden and the implication for health and social policies. The most commonly encountered chronic diseases are examined. The second volume dealt with diabetes mellitus (McGhee *et al*., 2009) and the third volume with dementia (Yu *et al*., 2010). Different chronic diseases affect elderly people in different ways, so each disease is considered separately. This report examines the implications of population ageing on the burden of chronic obstructive pulmonary disease (COPD). The burden of disease in terms of the absolute numbers of people affected is a combined result of the rate of onset of new disease (incidence), mortality rate from the disease, disease-specific quality of life indicators, and service utilisation rates. An examination of past trends over a number of years may inform future trends and estimation of burden and consequently needs. International comparison with other countries may provide an indication of how well health services are coping with disease burden, with respect to prevention as well as treatment.

Executive Summary

Executive Summary

Background

As a chronic disease, chronic obstructive pulmonary disease (COPD) imposes a huge burden worldwide. Smoking is considered as the primary cause of COPD. People develop COPD decades after their exposure to risk factors, thus leading to higher prevalence and incidence rate among older people. Although there is no increasing trend in the age-specific prevalence of COPD, the number of older COPD patients can be expected to increase owing to the larger number of older people who are most at risk of developing the disease. With the declining mortality from COPD, there is also an implication on direct medical costs as COPD patients often have frequent hospital admissions, and indirect costs relating to functional disability and poorer health-related quality of life. An examination of the trend in prevalence, incidence, mortality and morbidity therefore facilitates an accurate estimation of current and future burden of the disease for older people, as a consequence of the ageing population.

People develop COPD decades after their exposure to risk factors, thus leading to higher prevalence and incidence rate among older people.

Prevalence

According to self-reported doctor diagnoses, there was no clear evidence of either an increasing or a decreasing trend in the prevalence of COPD among older people in Hong Kong between 1991 and 2008. The 2003-2004 findings showed that self-reported prevalence rate of COPD in the population of age 65 and above was 4.6%. This estimated prevalence of COPD among older people in Hong Kong was far below the pooled estimate of prevalence of 14.2% from studies around the world. The Hong Kong estimate was also lower than that in the United States (US), the United Kingdom (UK), Australia, China and Japan. Based on the self-reported COPD prevalence, the number of known COPD cases for older people in Hong Kong was estimated to more than double between 2010 and 2036 from 0.04 million to 0.12 million, based on the effect of the demographic changes only.

The prevalence of COPD in Hong Kong is not decreasing.

The number of older COPD patients in Hong Kong was projected to more than double from 0.04 million in 2010 to 0.12 million in 2036, based on the effect of the demographic changes only.

Based on spirometry test data, the prevalence of COPD among those aged 60 and above varied from 12.4% to 25.9% depending on the diagnostic criteria. The Hong Kong findings were consistent with the other countries, where prevalence based on objective clinical tests was higher than the self-reported prevalence.

The prevalence of COPD based on spirometry test data could be as high as 12.4%-25.9% for people aged 60 and above in Hong Kong.

Incidence

There is limited information on the trend in incidence of COPD in Hong Kong, as well as worldwide. The incidence of COPD in Hong Kong appeared to be stable over 1991 to 2004. This trend was consistent with the global and Australian estimates. The COPD incidence amongst those aged 70 and above in Hong Kong was about 1 in 100. This incidence was lower than that in Japan, but higher than that in Australia. Nevertheless, similar to self-reported COPD prevalence data, self-reported COPD incidence data are likely to be under-estimated.

The incidence of COPD amongst those aged 70 and above in Hong Kong was stable at about 1 in 100 during the past decade.

Mortality

COPD is the sixth leading cause of death in Hong Kong. The age-adjusted COPD mortality rate in Hong Kong increased slightly in the early 80s, followed by a decreasing trend, with the exception of a peak in 1992. COPD mortality among people aged 65 and above followed a similar trend. In 2008, the COPD mortality for those aged 65 and above was 211.9 per 100,000, accounting for 6.0% of all deaths of the age group. The decreasing trend in recent years is consistent with that reported in the US, the UK, Australia, China and Japan. Age-adjusted COPD mortality rate in Hong Kong was similar to that in Australia and Singapore, and lower than that in the US, the UK and China.

The age-adjusted COPD mortality rate in Hong Kong has been decreasing since the late 80s.

The COPD mortality rate among those aged 65 and above in Hong Kong was 211.9 per 100,000 in 2008.

Disability

About 73.2% of the COPD patients aged 65 and above in Hong Kong had mild to severe functional limitations as defined by the Barthel Index. Over half of the older people with COPD reported difficulty in bathing (71.1%) and stair-climbing (54.6%). Similar functional limitations of COPD patients have been observed in overseas studies.

About 73.2% of the COPD patients aged 65 and above in Hong Kong had mild to severe functional limitations.

Health-Related Quality of Life (HRQoL)

Older people living with COPD in Hong Kong reported a relatively worse HRQoL in terms of physical and mental health as measured by SF-12. COPD patients aged 65 and above in Hong Kong also had poorer self-rated health and were more likely to have depressive symptoms as compared to those without COPD. These observations in Hong Kong were similar to studies conducted in other places.

Older COPD patients in Hong Kong had worse HRQoL and poorer self-rated health, and were more likely to have depressive symptoms than those without COPD.

Service utilisation

In Hong Kong, most hospital episodes with a primary diagnosis of COPD were utilised by those over 65 years old. This proportion increased from 64% in 1997 to 80% in 2006, which was higher when compared with the US, the UK, Australia and China. The age-adjusted hospitalisation rates of COPD in Hong Kong remained stable in 1997 to 2002, followed by a drop in 2003, and subsequently increased in 2004 and 2005. In 2005, the COPD hospitalisation rate (per 1,000) for men and for women aged 65 to 74 was 13.8 and 1.9, respectively. On average, the hospitalised COPD patients aged 65 and above spent more than a week per episode, or a total of 2 to 3 weeks a year. The COPD hospitalisation rate in Hong Kong was higher than that

The age-adjusted COPD hospitalisation rate in Hong Kong remained stable in 1997 to 2002, followed by a drop in 2003, and subsequently increased in 2004 and 2005.

in Australia, even after adjustment for age differences. However, the average length of stay in hospital per episode by older COPD patients in Hong Kong was similar to that in Australia.

On average, hospitalised COPD patients aged 65 and above spent more than a week in hospital per episode, or a total of 2 to 3 weeks a year.

Economic burden

Hospitalisation was the major component of direct costs of COPD. In 2006, over HK$985 million were spent on COPD hospitalisation in Hong Kong, the majority (86%) of which was for people aged 65 and over, accounting for HK$844 million. On average, the annual costs of hospital admissions incurred for each COPD patient were approximately HK$56,051, whereas the costs for each older patient were approximately HK$66,287. By 2036, the costs of hospitalisation for COPD patients aged 65 and above would increase to approximately HK$7.8 billion. As in the US and the UK, the direct costs increased with disease severity. The costs for severe COPD patients in Hong Kong were approximately 3 to 8 times of those with moderate disease. This would imply that preventing patients from moving from a moderate to a severe disease state would be worthwhile in terms of reducing costs as well as improving patients' quality of life. In addition, smoking accounted for HK$430 million public hospital costs of COPD in the population aged 35 and above in 1998. This finding indicated that smoking cessation could help to reduce the direct costs incurred.

By 2036, it was projected that approximately HK$7.8 billion would be spent on COPD hospitalisation among people aged 65 and above in Hong Kong.

On average, the annual costs of hospital admissions incurred for each older COPD patient were approximately HK$66,287.

Factors affecting burden of COPD

In Hong Kong, despite an overall decline in the prevalence of current daily smokers among adults, the smoking prevalence in the younger female population has increased over the years. This trend may result in an increase in COPD prevalence and mortality among older women in later years. The increase in smoking prevalence in the younger female population was also observed in China, Japan and Singapore.

While smoking is a well-known risk factor for COPD, there are other less well-established risk factors such as second-hand smoke and outdoor air pollution. It is worth noting that a significant association was identified between high levels of air pollution in Hong Kong and increased hospital admissions of chronic respiratory disease. Further studies are needed to fully examine the risk of COPD associated with second-hand smoke and air pollution.

The increased smoking prevalence in the younger female population in Hong Kong may result in an increase in COPD prevalence and mortality trend among older women.

Further studies are needed to fully examine the risk of COPD associated with second-hand smoke and air pollution.

Conclusions and implications

Since there is an increasing prevalence rate with age, the numbers of older people with COPD would be expected to rise. The substantial direct and indirect costs as a result of COPD indicate that preventive efforts should receive high priority in health policies. Some strategies are:

- Preventive efforts in reducing uptake of smoking, smoking cessation, as well as reducing air pollution.
- Identification of factors that may prevent the progression from mild to severe COPD.
- Provision of better structured primary care for COPD patients, taking into account the functional dependencies and psychological morbidities, in addition to pharmacological aspects.
- Organisation of group community rehabilitation which may provide psychological support and maximise physical function.
- Provision of appropriate end-of-life care.

Preventive efforts related to COPD should receive high priority in health policies.

Chapter 1

Introduction

Chapter 1
Introduction

1.1 Overview

Chronic obstructive pulmonary disease (COPD) is a chronic lung disease that results in obstruction of the airways. It usually refers to two disorders: chronic bronchitis and pulmonary emphysema. According to the Global initiative for Chronic Obstructive Lung Disease (GOLD), COPD is defined as a preventable and treatable disease with some significant extra-pulmonary effects that may contribute to the severity in individual patients; its pulmonary component is characterised by airflow limitation which is usually caused by an abnormal inflammatory response of lungs to noxious particles or gases (GOLD, 2009). COPD patients suffer from intolerance to daily activity and sleep disturbance leading to poor quality of life.

Tobacco smoking is considered to be the most important factor in causing and exacerbating COPD, with estimates of 80 to 90% of COPD caused by smoking (Wagena, Huibers & van Schayck, 2001). Indoor and outdoor air pollutants, occupational exposure to chemicals and dusts as well as some genetic conditions (e.g. α_1-antitrypsin deficiency) are also related to the onset of COPD. Other factors such as poor nutrition, restricted lung growth and development, social-economic status and asthma may also be risk factors for the development of COPD but the evidence is inconclusive (GOLD, 2009).

The disease state declines progressively, that is, not fully reversible with treatment (WHO, 2008a). Prompt diagnosis and counselling on reduction of exposure to the risk source, in particular tobacco smoke, would help to reserve lung function and delay disease progression (Anthonisen *et al*., 1994). Severe cases have to rely on long-term medication, oxygen therapy, surgical intervention (as indicated) and trained self-management modalities to improve quality of life.

Early symptoms of COPD are unique to each person, and may vary in each episode of the same person. Some of the symptoms in early stages of COPD include chronic cough, sputum production and dyspnoea. Patients with advanced COPD have more breathing difficulties; respiratory failure, right heart failure, weight loss, and arterial hypoxemia are potential complications (GOLD, 2009).

1.2 Diagnosis and severity classification

COPD is diagnosed by spirometry (lung function test), which measures Forced Vital Capacity (FVC) - how deeply a person can breathe - and Forced Expiratory Volume in one second (FEV_1) - how fast air can move out of the lungs (WHO, 2008a). In order to differentiate the diagnosis between COPD and asthma, spirometry is performed before and after the administration of a bronchodilator. If the degree of airflow normalises or significantly improves, asthma is indicated.

The stages of severity of COPD are used to investigate the impact of the disease on patients and lead to an effective approach to COPD management. Specific spirometric cut-points of post-bronchodilator FEV_1 are used to denote the severity of pathological changes in COPD. GOLD-devised empiric cut-points which divide COPD into four stages, are widely used (Table 1.1) (GOLD, 2009). While the fixed ratio of $FEV_1/FVC < 0.70$ had been supported (Johannessen *et al*., 2006), other cut-points have not been clinically validated.

Table 1.1 Spirometric classification of COPD severity (Stages I to IV) based on post-bronchodilator FEV_1

Stage	Description	Criteria
Stage I: Mild	- mild airflow limitation - chronic cough and sputum production may be present - unawareness of lung function abnormity	$FEV_1/FVC < 0.70$ *and* $FEV_1 \geq 80\%$ predicted
Stage II: Moderate	- worsening airflow limitation - shortness of breath - cough and sputum production may be present - seek medical attention	$FEV_1/FVC < 0.70$ *and* $50\% \leq FEV_1 < 80\%$ predicted
Stage III: Severe	- further worsening of airflow limitation - greater shortness of breath - reduced exercise capacity, fatigue and repeated exacerbations - quality of life deteriorated	$FEV_1/FVC < 0.70$ *and* $30\% \leq FEV_1 < 50\%$ predicted
Stage IV: Very severe	- severe airflow limitation - quality of life impaired - exacerbations may be life-threatening	$FEV_1/FVC < 0.70$ *and* (i) $FEV_1 < 30\%$ predicted or (ii) $FEV_1 < 50\%$ predicted plus chronic respiratory failure*

* *Respiratory failure: arterial partial pressure of oxygen (PaO_2) less than 8.0 kPa (60mm Hg) with or without arterial partial pressure of CO_2 ($PaCO_2$) greater than 6.7 kPa (50mm Hg) while breathing air at sea level*

Data source: GOLD (2009)

As lung volumes are likely to be lower when one ages, the fixed ratio of $FEV_1/FVC < 0.70$ may lead to over-diagnosis of COPD in the older population. An alternative definition of using lower limit of normal (LLN) values for FEV_1/FVC (based on the lowest 5th percentile of the normally distributed healthy population) can be used to take into account the decreasing FEV_1/FVC ratio with age and minimise misclassification (American Thoracic Society, 1991).

1.3 Clinical coding and self-reported data

The International Classification of Diseases (ICD) is a system used to uniquely classify diseases and other health-related problems and is applied to records of deaths and hospital discharges. There is no separate ICD code for COPD. The set of codes with the closest coverage is the group "chronic lower respiratory diseases" in ICD 9th version (490-496) or "COPD and allied conditions" in ICD 10th version (J40-J47). Since further breakdown of statistics were not available in some countries we selected for comparison, for consistency, these broad groups were adopted in our analysis even though they included some conditions which were not strictly classified as COPD.

In Hong Kong, the 9th Revision of ICD (ICD-9) was used before 2001 and the 10th Revision (ICD-10) from 2001 onwards. A comparability study of ICD-9 and ICD-10 coding for cause of death showed that the codes for chronic lower respiratory diseases were more or less comparable under the two coding systems (Tsang & Cheung, 2005). Nevertheless, a change in coding systems was noted in analyses of mortality and hospitalisation trends.

1.4 Data quoted in this report

This report examines all stages of COPD with the specific stage explicitly stated. In most of the reported surveys where COPD was identified through self-reported previous diagnosis by a doctor, their validity could not be further verified. However, self-reported diagnoses that were validated from clinical data were noted. For most of the mortality and health care utilisation statistics, COPD was identified through ICD codes. In this report, where possible, the ICD codes have been specified.

As the statistics quoted in this report were compiled from different sources, the conceptualisation and compilation methods could vary considerably across studies. The comparisons presented in this report, therefore, can only be interpreted in a broad sense. It is recommended that readers consult the cited references for the meta-data of the studies. For easy reference, the currencies mentioned in this report are converted to US dollars by the average exchange rate in the corresponding years.

Chapter 2

The Worldwide Trends and Burden of COPD

Chapter 2

The Worldwide Trends and Burden of COPD

2.1 Prevalence worldwide

As a chronic disease, COPD imposes a huge burden worldwide and this burden will increase in ageing populations (Mannino & Buist, 2007). The World Health Organization (WHO) estimated that the worldwide prevalence rate of COPD remained at around 1.0% for the period of 2000 to 2004 but the number of COPD cases has been increasing (Table 2.1) (WHO, 2002a, 2004, 2008b).

Table 2.1 Worldwide prevalence of COPD, 2000-2004

	2000	2002	2004
Prevalence rate	0.99%	1.02%	0.99%
Number of people with COPD	59.9 million	62.5 million	63.6 million

Data sources: WHO (2002a, 2004, 2008b)

A systematic review and meta-analysis of papers published from 1990 to 2004 found 37 estimates for the global prevalence of COPD and yielded a pooled prevalence rate estimate of 7.6% (95% CI: 6.0%-9.5%) (Table 2.2) (Halbert *et al.*, 2006). The prevalence rate in people aged 65 and over was estimated to be higher than other age groups at 14.2% (95% CI: 11.0%-18.0%).

Table 2.2 Estimated worldwide prevalence rates of COPD, by age group, 1990-2004

Age group	Pooled prevalence rate (95% CI)
<40 years	3.1% (1.8%-5.0%)
40-64 years	8.2% (6.5%-10.3%)
≥65 years	14.2% (11.0%-18.0%)
Overall	7.6% (6.0%-9.5%)

Data source: Halbert et al. (2006)

The pooled prevalence rate of COPD based on spirometry tests was 9.2% (95% CI: 7.7%-11.0%) which was higher than that from self-reported diagnoses (pooled prevalence rate of 4.9%, 95% CI: 2.8%-8.3%), indicating that self-reported prevalence tended to under-estimate the true prevalence (Halbert *et al*., 2006). Another study estimated from spirometric results that the worldwide prevalence rate of moderate to very severe COPD among those aged 40 and above was 10.1% (Buist *et al*., 2007).

The Americas had the highest COPD prevalence rate (1.5%) in 2004 among all WHO sub-regions, followed by Europe (1.3%) and Western Pacific (1.2%) (WHO, 2008b). Using a COPD prevalence model which incorporated local prevalence of risk factors of COPD (e.g. smoking prevalence, exposure to non-smoking factors), the prevalence rate of moderate to severe COPD among those aged 30 and above in 12 Asian countries and regions in 2000 (including Australia, China, Hong Kong, South Korea, Malaysia, Philippines, Singapore, Taiwan, Vietnam, Thailand, Indonesia and Japan) was as high as 6.3% (Regional COPD Working Group, 2003). On the other hand, while Europe has previously had a relatively lower prevalence rate of COPD, the prevalence rate of COPD in the European Union has steadily increased from 1990 to 2007 (WHO Regional Office for Europe, 2010).

2.2 Incidence worldwide

In the World Health Report, an annual incidence for COPD was estimated (WHO, 2002a, 2002b, 2004). The worldwide incidence of COPD, both in terms of rate and absolute number, was stable at around 0.9 per 1,000 population over the years 2000 to 2002 (Table 2.3). COPD incidence generally increased with age. The incidence for those aged 80 and above was substantially higher than the other age groups (Lopez *et al*., 2006c).

Table 2.3 Worldwide incidence of COPD, 2000-2002

	2000	2001	2002
Number of COPD cases	5.4 million	5.6 million	5.4 million
Incidence rate (per 1,000)	0.90	0.92	0.88

Data sources: WHO (2002a, 2002b, 2004)

Western Pacific had the highest COPD incidence rate (1.2 per 1,000) among all WHO sub-regions in 2002, followed by the Americas (1.1 per 1,000) and Europe (0.9 per 1,000) (WHO, 2004). While the incidence rates in most of the WHO sub-regions were stable over years 2000 to 2002, the rates in South East Asia and Eastern Mediterranean nearly doubled, yet the rate in Western Pacific decreased moderately (WHO, 2002a, 2002b, 2004).

2.3 Mortality worldwide

COPD was the fourth leading cause of death worldwide in 2004, and WHO predicted that it would become third by 2030 (WHO, 2008d). The number of deaths due to COPD was estimated to slightly increase from 2.6 million in 2000 to 3.0 million in 2004 (WHO, 2002a, 2004, 2008b). The proportion of deaths due to COPD worldwide also increased from 4.7% in 2000 to 5.1% in 2004. It was projected that number of deaths due to COPD would increase dramatically in the next decades unless risk reduction interventions, especially in tobacco smoke, are effectively implemented. By 2030, the number of deaths due to COPD was projected to nearly double from 3.0 million in 2004 to 5.8 million, accounting for 8.6% of all deaths (Table 2.4) (WHO, 2008c).

The COPD mortality rate was found to increase sharply with age. In 2004, the COPD mortality rate was 36.4 per 100,000 for those aged 45 to 59, whilst such rate increased to 1,146.4 per 100,000 for those aged 80 and above (WHO, 2008b). While the worldwide COPD mortality rate slightly increased from 43.4 per 100,000 in 2000 to 47.0 per 100,000 in 2004, the trends in age-specific COPD mortality rate varied (WHO, 2002a, 2008b). The mortality rate of those aged 60 to 79 slightly increased, but that of those aged 80 and above decreased.

Table 2.4 Worldwide number of deaths from COPD, 2000-2004 and projection for 2030

	2000	2002	2004	2030
Number of deaths due to COPD	2.6 million	2.7 million	3.0 million	5.8 million
Proportion of deaths due to COPD	4.7%	4.8%	5.1%	8.6%

Data sources: WHO (2002a, 2004, 2008b, 2008c)

Western Pacific had the highest COPD mortality rate (86.7 per 100,000) among all WHO sub-regions in 2004, followed by South East Asia (49.1 per 100,000) and the Americas (27.4 per 100,000) (WHO, 2008b). The mortality trends in Asia varied from an increasing trend in Taiwan to a decreasing trend in Singapore (Ko, Hui & Lai, 2008). Due to the large population in Asia, COPD burden in terms of number of deaths is high.

Looking at the 15 countries in the European Union (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom), the age-adjusted mortality rate varied significantly across countries and over time (European Commission, 2010). The overall rate for these European countries dropped from 24.5 per 100,000 in 1994 to 18.2 in 2007.

2.4 Disability-Adjusted Life Years (DALYs) worldwide

In terms of healthy life lost, WHO estimated that COPD caused more than 26 million disability-adjusted life years (DALYs) worldwide in 2000 (Lopez *et al*., 2006c). It was projected that DALYs lost to COPD would be nearly 52 million in 2030 (WHO, 2008c). In low and middle income countries, DALYs lost to COPD in 2001 amounted to 33.5 million, compared with 5.3 million in high income countries (Lopez *et al*., 2006a).

Table 2.5 shows the variation in DALYs lost to COPD throughout the world (Chan-Yeung *et al*., 2004), which reflects average ages of the populations and smoking prevalence. DALYs lost due to mortality and morbidity from COPD in 2001 were estimated at approximately 30 million, of which more than two-thirds were observed in Western Pacific and South East Asia. Taking into account the population size, Western Pacific still had the highest DALYs per 1,000 population (8.1), followed by Eastern Mediterranean (7.7) and South East Asia (4.8).

Table 2.5 Worldwide estimates of DALYs lost to COPD, by region, 2001

Region	DALYs	DALYs per 1,000 population
Africa	1.1 million	1.7
Americas	3.0 million	3.6
Eastern Mediterranean	3.7 million	7.7
Europe	1.0 million	1.1
South East Asia	7.4 million	4.8
Western Pacific	13.7 million	8.1
World	29.9 million	4.9

Data sources: Chan-Yeung et al. (2004) and authors' calculations

2.5 Summary

The worldwide prevalence rate of COPD remained at around 1.0% for the period of 2000 to 2004, where the absolute number of COPD cases has been increasing. The worldwide incidence rate of COPD was stable at around 0.9 per 1,000 in years 2000 to 2002. The worldwide number of deaths due to COPD was projected to nearly double from 3.0 million in 2004 to 5.8 million by 2030, accounting for 8.6% of all deaths. Western Pacific had the highest COPD incidence rate, mortality rate as well as DALYs among all WHO sub-regions.

Chapter 3

Trends in COPD Prevalence in Hong Kong

Chapter 3

Trends in COPD Prevalence in Hong Kong

3.1 Introduction

Hong Kong has a rapidly ageing population. The population aged 65 and above nearly doubled during the past two decades, from 482,800 in 1990 to 916,600 in 2010 (Census and Statistics Department of Hong Kong Special Administrative Region (SAR), 2010b). It is projected that in 2036, there will be 2,389,100 people aged 65 and above in Hong Kong (Census and Statistics Department of Hong Kong SAR, 2010a).

As demonstrated in the worldwide trend, despite a non-increasing trend in the age-specific prevalence rate of COPD, the number of older people with COPD has been increasing over the years owing to the increasing number of older people, who demonstrate a higher COPD prevalence rate. As a result, an increasing number of older people with COPD will be observed in Hong Kong in the future unless exposure to risk factors is substantially reduced. This chapter reviews the trends in COPD prevalence and calculates current estimates and future projections of the number of people with COPD in Hong Kong. Prevalence rates reported in previous studies in Hong Kong are also compared with other countries.

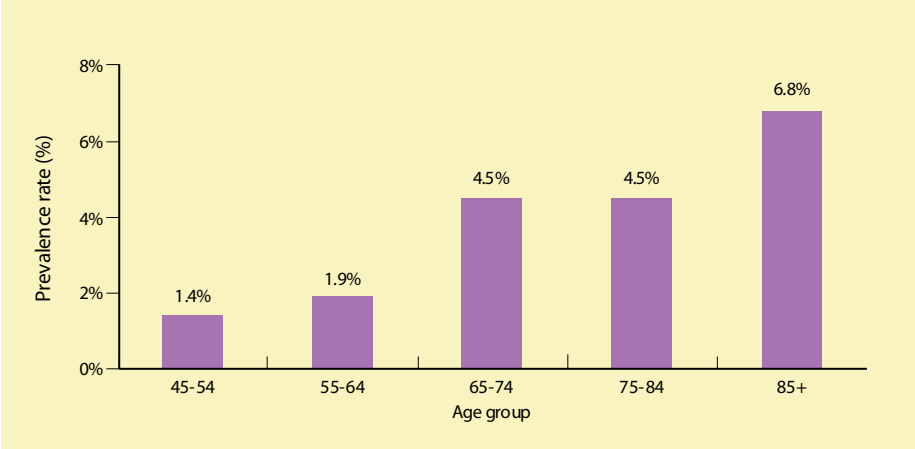
3.2 Previous estimates of COPD prevalence

The prevalence of COPD can be estimated by self-reported data or clinical diagnosis based on spirometric data. However, data on prevalence of COPD in Hong Kong is lacking partly because of the difficulty in defining the clinical cases. Therefore, instead of directly estimating prevalence of COPD, prevalence of various respiratory problems including chronic bronchitis, emphysema, bronchiectasis and chronic obstructive airway disease (COAD) was estimated in some studies. Here, different prevalence estimates are presented.

3.2.1 Prevalence based on self-reported data

The Population Health Survey (PHS) conducted in 2003-2004 was the first to estimate the prevalence rate of self-reported COPD in the population aged 15 years and above, and found it to be 1.4% (Department of Health of Hong Kong SAR and Department of Community Medicine of The University of Hong Kong (HKU), 2005). The age-specific prevalence rates increased with age (Figure 3.1). The prevalence rate of self-reported COPD among those aged 65 and above was estimated to be 4.6%.

Figure 3.1 Prevalence rates of self-reported doctor-diagnosed COPD in Hong Kong, by age group, 2003-2004



Data source: Department of Health of Hong Kong SAR and Department of Community Medicine of HKU (2005)

The prevalence rate of COPD can be reflected by the prevalence rates of COAD, chronic bronchitis, emphysema and bronchiectasis. Based on the database of older people enrolled in the Department of Health Elderly Health Centres (EHC) between 1998 and 2001, the prevalence rate of self-reported COAD among people aged 65 and above decreased from 6.2% in 1998 to 5.1% in 2001. On the other hand, another local study found that the prevalence rate of chronic bronchitis or emphysema among those aged 70 and above increased from 8.1% in 1991-1992 to 9.0% in 2003-2004 (Ko *et al.*, 2006). Owing to limited data, there is no clear-cut trend in the prevalence of COPD in Hong Kong.

Table 3.1 summarises the self-reported prevalence rates of various respiratory problems. Rates should be compared with caution because of dissimilarities in study populations and the definition of cases, as well as the self-reporting nature of the data.

Table 3.1 Prevalence rates of respiratory problems from self-reported data, Hong Kong, 1991-2008

Year	Age	Sample Characteristics	Respiratory problems	Prevalence rate	Source
1991-1992	70+	Older people receiving allowance from the government and living in the community or in institutions	Chronic bronchitis or emphysema	8.1%	Ho *et al.* (1994)
1998	65+	Older Chinese people living in the community	Chronic bronchitis	10.0%	Harvard University and HKU (1998)
1998-1999	65+	Older Chinese people living in the community	COAD	6.0%	Chu *et al.* (2005)
1998-2001	65+	Attendees of EHC	COAD	5.6%	Data from EHC of Department of Health of Hong Kong SAR
1999	65+	Older people living in the community	Chronic bronchitis, emphysema or bronchiectasis requiring long-term follow-up by doctors	1.8%	Census and Statistics Department of Hong Kong SAR (2000)
2001	65+	Older people living in the community	Chronic bronchitis, emphysema or bronchiectasis requiring long-term follow-up by doctors	2.6%	Census and Statistics Department of Hong Kong SAR (2002)
2003-2004	70+	Older people living in the community	Chronic bronchitis or emphysema	9.0%	Ko *et al.* (2006)
2003-2004	65+	Older people living in the community	COPD	4.6%	Department of Health of Hong Kong SAR and Department of Community Medicine of HKU (2005)
2008	60+	Older people living in the community or in institutions	Chronic bronchitis, emphysema or asthma	Community: 4.1% Institutions: 8.4%	Census and Statistics Department of Hong Kong SAR (2009)

3.2.2 Prevalence based on lung function test

Spirometry is one of the lung function tests commonly used to diagnose COPD. Based on spirometric data, the prevalence rate of COPD ($FEV_1/FVC < 0.7$) among 165 subjects aged 70 and above was 10.9% in 2003 and the prevalence rate of moderate to very severe COPD ($FEV_1/FVC < 0.7$ and $FEV_1 < 80\%$ predicted) was about 6.7% (Ko *et al*., 2006). Nevertheless, this study might be limited by its small sample size.

Another recent study estimated the prevalence rate of COPD ($FEV_1/FVC < 0.7$) among people aged 60 and above to be 25.9% (Ko *et al*., 2008). Based on GOLD criteria, 46.0% of these patients had mild COPD ($FEV_1/FVC < 0.7$ and $FEV_1 \geq 80\%$ predicted), 43.7% moderate ($FEV_1/FVC < 0.7$ and $50\% \leq FEV_1 < 80\%$ predicted), 9.6% severe ($FEV_1/FVC < 0.7$ and $30\% \leq FEV_1 < 50\%$ predicted) and 0.7% very severe ($FEV_1/FVC < 0.7$ and $FEV_1 < 30\%$ predicted). Thus, the prevalence rate of moderate to very severe COPD was about 14.0%. Based on the same study, but using the alternative definition of COPD which takes into account the decreasing FEV_1/FVC ratio with age, the prevalence rate of COPD (based on LLN values of the FEV_1/FVC ratio) among those aged 60 and above was still as high as 12.4%. Prevalence based on either definition was higher than self-reported prevalence, implying that under-diagnosis of COPD is common.

3.2.3 Under-estimation of COPD prevalence

Prevalence based on self-reported data is usually under-estimated because of under-diagnosis of COPD. This discrepancy between prevalence based on self-reported data and that based on spirometry shown in the previous sections suggests that there are undiagnosed COPD cases in Hong Kong.

We used relevant data from the EHC cohort to examine the scope of under-diagnosis of COPD in Hong Kong. EHC nurses interviewed the enrolees on their existing health problems and provided physical examinations. Assuming that anyone who reported no history of COPD but were then diagnosed to have COPD by spirometry, we estimated that 307 out of 4,052 (7.6%) COPD cases among the EHC enrolees were under-diagnosed (Table 3.2). Adding the under-diagnosed cases to the self-reported cases, the prevalence rate of COPD among people aged 65 and above in Hong Kong is estimated to be 6.1% in 1998-2001, which is larger than the self-reported prevalence rate of 5.6%. Although the EHC enrolees may not be representatives of all older people in Hong Kong, this analysis indicates that under-diagnosis of COPD is an existing problem in Hong Kong.

Table 3.2 Under-diagnosis of COPD# among EHC enrolees (aged 65 and above), Hong Kong, 1998-2001

COPD cases aged 65+	Number
Self-reported: previous doctor-diagnosed COPD	3,745
Self-reported: no known COPD; subsequently diagnosed to have COPD by spirometry test	307
Total number of COPD cases	4,052
Percentage of under-diagnosed cases	7.6%

 # Exact phrase in the EHC questionnaire was "COAD".
Data source: Authors' calculations

3.3 Current and future estimates of COPD prevalence

Multiplying the age- and sex- specific prevalence rate of self-reported previous doctor-diagnosed COPD from PHS 2003/2004 by the corresponding population, the total number of people in Hong Kong with known COPD was estimated. Self-reported prevalence was used for calculation of estimates because it represented the number of people who were being treated. Of course, these numbers did not include the undiagnosed cases.

Assuming the age-sex-specific prevalence rates between 2003/2004 and 2010 remain unchanged, it was estimated that there were over 90,000 people aged 40 and above with known COPD in Hong Kong, of which about half were aged 65 and above. Using the same methodology, the number of people aged 65 and above with COPD is estimated to increase further to 117,112 by 2036, at 2.6 times compared with 2010. The increase in COPD cases among population aged 85 and above will be even faster, estimated at 3.2 times in 2036 as compared with 2010 (Table 3.3). To compensate for the effect of the growing older population and to avoid increase in the absolute number of people with COPD, the prevalence rate has to be reduced substantially. Taking the population aged 85 and above as an example, if the number of COPD cases were to remain at the 2010 level, the prevalence rate of this group in 2036 will need to be reduced to less than one-third of the present value.

Table 3.3 Projected numbers of people with known COPD in Hong Kong, 2010 and 2036

	2010			2036		
Age group	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
40-54	17,230	11,559	28,789	13,667	12,483	26,151
55-64	9,644	7,061	16,705	10,908	9,488	20,396
65-74	15,180	5,339	20,519	31,557	14,939	46,496
75-84	11,842	3,722	15,564	33,126	10,257	43,383
85+	6,126	2,509	8,635	20,463	6,770	27,233
40-64	26,874	18,620	45,494	24,575	21,971	46,546
65+	33,148	11,570	44,718	85,146	31,966	117,112
Total (40+)	60,022	30,190	90,213	109,721	53,937	163,658

Note: Individual cells may not sum up to total due to rounding.
Data source: Authors' calculations

Assuming the percentage of undiagnosed COPD case was the same as that in the EHC cohort (7.6%), the estimated number of people aged 65 and above with COPD would be 48,396 in 2010 and 126,745 in 2036 (Table 3.4).

Table 3.4 Projected number of people aged 65 and above with COPD in Hong Kong, 2010 and 2036

Aged 65+	**2010**	**2036**
Number of people with known COPD	44,718	117,112
% of undiagnosed COPD	7.6%	7.6%
Number of people with COPD (both known and unknown)	48,396	126,745

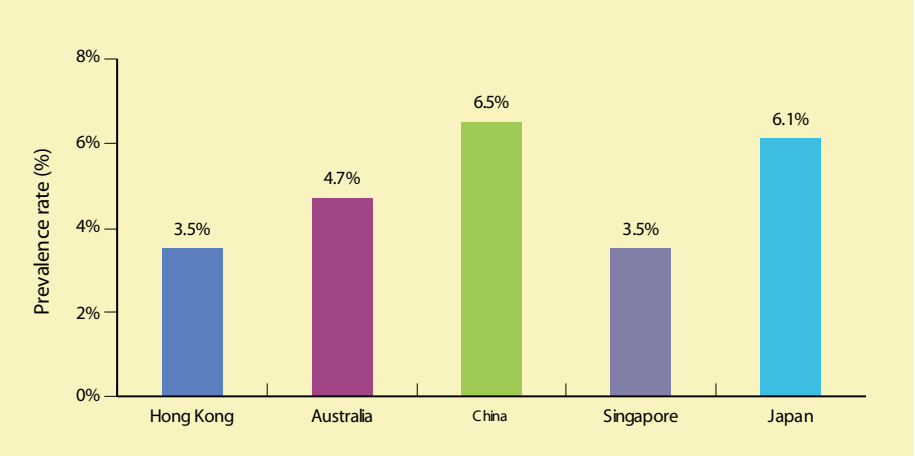
Data source: Authors' calculations

The above estimates were based on the assumption that the rates of COPD in Hong Kong remain the same until 2036, with changing demographics only. If the age-specific prevalence rate increases, the number of people with COPD would be larger than our estimates above.

3.4 Comparison of prevalence with other countries

Based on the prevalence of risk factors in each place, a projection model estimated that the prevalence rate of moderate to severe COPD among the population aged 30 and above in 2000 was relatively low in Hong Kong (3.5%) as compared with those in other Asia-Pacific countries, such as China (6.5%), Japan (6.1%) and Australia (4.7%). The prevalence rate in Singapore (3.5%) was the same as in Hong Kong (Figure 3.2) (Regional COPD Working Group, 2003).

Figure 3.2 Model projected prevalence rates of moderate to severe COPD in population aged 30 and above in Asia-Pacific region, 2000



Data source: Regional COPD Working Group (2003)

Owing to the differences in conceptualisation and compilation methods, international comparisons can only be conducted in a broad sense. Details about trends in individual countries are presented in subsequent sections.

3.4.1 United States

According to the National Health Interview Survey, the age-adjusted prevalence rate of self-reported COPD in the United States (US) increased from 1980 to 1995, but decreased in the late 90s (Table 3.5) (Mannino *et al*., 2002). COPD was reported more frequently in people aged 65 to 74 and prevalence rate in this age group fluctuated slightly, with a drop between 1980 to 2000. Although prevalence rate in people 75 years and over was not as high as that in those aged 65 to 74 in 1980s, it went up a little through the years and caught up with those aged 65 to 74 in 1999. The prevalence rates reported here were stated by the authors of the report to be under-estimated due to the unrecognised early natural history of COPD and the trends might be affected by the re-design of the survey in 1997.

Table 3.5 The estimated prevalence rates of self-reported COPD#, by age group, United States, 1980-2000

Age group	1980	1985	1990	1995	2000
45-54	5.1%	5.4%	5.9%	6.7%	5.9%
55-64	7.1%	7.4%	7.5%	8.1%	8.0%
65-74	11.4%	10.9%	11.2%	9.1%	9.6%
75+	7.5%	8.9%	9.8%	8.8%	10.6%
Whole Population (25+) (age-adjusted*)	5.6%	6.1%	6.3%	6.4%	6.0%

 # Data from 1980-1996 was self-reported lifetime emphysema or chronic bronchitis during the preceding 12 months and data for 1997-2000 was self-reported, physician-diagnosed lifetime emphysema or chronic bronchitis during the preceding 12 months.

** Age-adjusted to 2000 US population.*

Data source: Mannino et al. (2002)

During the period 1999 to 2008, the prevalence of chronic bronchitis in US adults (aged 18 and above) remained stable, except for a notable increase in 2001 and then a notable decline in 2007. During the same period, no notable change was observed in prevalence of emphysema (National Center for Health Statistics, 2009). This implied a possible stable trend of COPD prevalence in the US in recent years.

Based on spirometric data, the prevalence rates of COPD ($FEV_1/FVC < 0.7$) were 37.2% for those aged 65 to 74 and 40.8% for those aged 75 and above in 1988-1994 (Mannino *et al.*, 2002). Under-diagnosis of COPD was indicated by the findings that about 12.0% of people aged 45 and above had undiagnosed airflow obstruction while only 3.1% reported doctor-diagnosed COPD (Coultas *et al.*, 2001).

3.4.2 United Kingdom

Data from the United Kingdom (UK) patient records in 1990-1997 showed the annual prevalence rate of physician-diagnosed COPD in women increased from 0.8% to 1.4%, compared with an increase from 1.4% to 1.7% in men (Soriano *et al.*, 2000). Women aged above 65 showed striking increase in the prevalence rate in the same period. Again, data based on patient records may be under-estimated. Data on the recent trend are not available. A recent Health Survey for England found that the prevalence rates of self-reported doctor-diagnosed COPD among population aged 65 and above were about 9% for men and 7% for women in 2005 (Table 3.6) (The Information Centre, National Health Service (NHS) of UK, 2007).

Table 3.6 Prevalence rates of self-reported doctor-diagnosed COPD, by age group and sex, England, 2005

Age group	Male	Female
65-69	7%	6%
70-74	10%	6%
75-79	8%	7%
80-84	13%	8%
85+	13%	9%
Total (65+)	9%	7%

Data source: The Information Centre, NHS of UK (2007)

Based on spirometry test in a general practice population, the prevalence rate of moderate to very severe COPD ($FEV_1/FVC < 0.7$ and $FEV_1 < 80\%$ predicted) was estimated to be 14.1% among those aged 60 to 79 in 2001 (Frank *et al.*, 2007). The age-specific prevalence rate was the highest for age group 60 to 69 (14.7%), followed by those aged 70 to 79 (13.6%). Nevertheless, estimates based on patient records are subject to under-estimation as under-diagnosis of COPD is common.

It was estimated that over 80% of COPD cases among those aged 35 and above in England were undiagnosed (Shahab *et al.*, 2006). While undiagnosed cases were more common for mild COPD, over half of the severe or very severe COPD cases were undiagnosed. Another study also estimated that nearly half of the COPD cases among those aged 15 and above in England were undiagnosed (Nacul, Soljak & Meade, 2007).

3.4.3 Australia

The estimated prevalence rate of COPD in Australia based on modelling was 1.9% in men and 1.3% in women in 1996 (Mathers, Vos & Stevenson, 1999). In 2003, such prevalence rate increased to 2.3% and 1.6% in men and women, respectively (Begg *et al.*, 2007). However, it was uncertain whether the increase was continuous in-between the two years. In 2005-2006, the prevalence rate of COPD among the general population was estimated to be 2.3% (Knox *et al.*, 2008).

Based on data from The Burden of Obstructive Lung Disease (BOLD) study and the National Health Survey of Australian Statistics Bureau, the most recent study estimated that the prevalence rate of moderate to very severe COPD ($FEV_1/FVC < 0.7$ and $FEV_1 < 80\%$ predicted) was 5.6% in 2008, and the prevalence rate was projected to increase to 6.9% in 2030 and 7.5% in 2050 (Access Economics Pty Limited, 2008).

COPD prevalence increased sharply with age (Table 3.7) (Begg *et al*., 2007). In 2003, the estimated COPD prevalence rate among the population aged 75 and above was 15.0% and 8.5% for men and women, respectively.

Table 3.7 The estimated prevalence rates of COPD, by age group and sex, Australia, 2003

Age group	Male	Female
65-74	10.0%	5.6%
75+	15.0%	8.5%
Whole population	2.3%	1.6%

Data source: Begg et al. (2007)

3.4.4 China

A population-based cross-sectional survey was conducted in three urban areas and two rural areas in China in 2000-2001 (Xu *et al*., 2005). The prevalence rate of self-reported doctor-diagnosed COPD was 5.9% among those aged 35 and above. COPD prevalence increased substantially with age, with the prevalence rate coming at 6.1% and 13.4% in those aged 50 to 64 and those aged 65 and above, respectively (Table 3.8).

Table 3.8 Prevalence rates of self-reported doctor-diagnosed COPD, by age group, China, 2000-2001

Age group	Prevalence rate
35-49	2.3%
50-64	6.1%
65+	13.4%
Total (35+)	5.9%

Data source: Xu et al. (2005)

Another population-based cross-sectional survey was conducted in seven provinces or cities in 2002-2004 (Zhong *et al*., 2007). Based on spirometric data, overall prevalence rate of COPD (FEV_1/FVC < 0.7) among people aged 40 and above was 8.2%, with 8.8% in rural areas and 7.8% in urban areas. The prevalence rate increased with age, with the rate among those aged 60 to 69 being 11.7% and those aged 70 and above being 20.4%. It was estimated that about 65% of the COPD cases among those aged 40 and above were undiagnosed.

3.4.5 Japan

The Nippon COPD Epidemiology (NICE) study in Japan used spirometry tests in subjects aged 40 years and above and found that 10.9% of the subjects had COPD ($FEV_1/FVC < 0.7$) in 2000 (Fukuchi *et al.*, 2004). In people aged 70 years old and above, the prevalence rate went up to 24.4% (Table 3.9). There was a high degree of under-diagnosis of COPD as suggested by the findings that only 9.4% of those with spirometry tested COPD cases had a previous COPD diagnosis.

Table 3.9 Prevalence rates of COPD based on spirometry, by age group, Japan, 2000

Age group	Prevalence rate
40-49	3.5%
50-59	5.8%
60-69	15.7%
70+	24.4%
Total (40+)	10.6%

Data source: Fukuchi et al. (2004)

In another study conducted in 2003-2004, the prevalence rate of COPD based on spirometry ($FEV_1/FVC < 0.7$) among subjects aged 40 to 69 attending medical check-ups was 7.0% (Omori *et al.*, 2007). Again, under-diagnosis of COPD was serious, with only 1.1% of the cases having had a previous diagnosis.

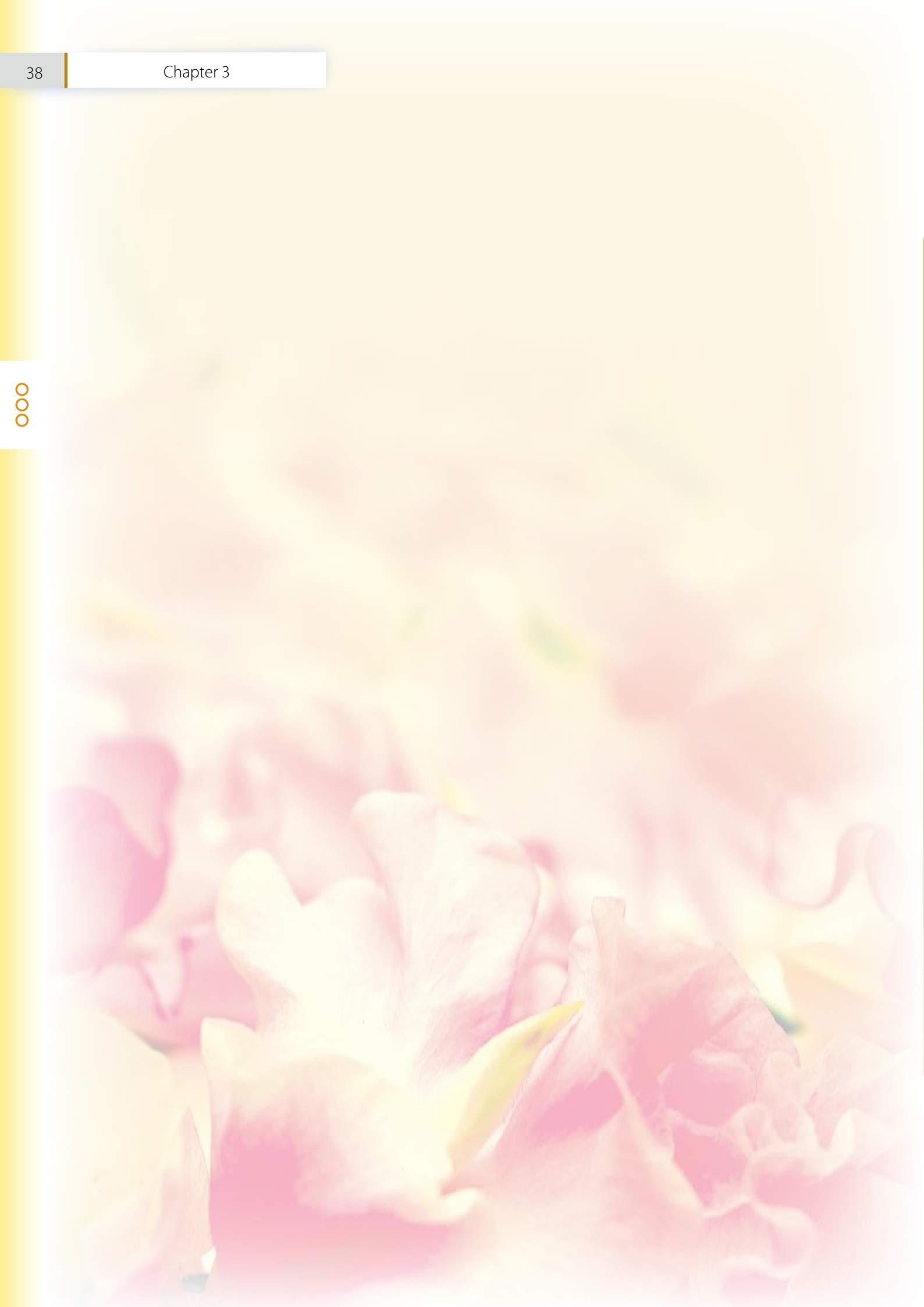
3.5 Summary

According to self-reported doctor diagnoses, there was no clear evidence of either an increasing or a decreasing trend in the prevalence of COPD among older people in Hong Kong between 1991 and 2008. Trends by country were inconsistent that the US showed a possible stable trend, whereas Australia showed an increasing trend.

The 2003-2004 findings showed that self-reported prevalence rate of COPD among those aged 65 and above in Hong Kong was 4.6%. However, it was estimated that 7.6% of all COPD cases were undiagnosed in 1998-2001. Based on the prevalence of self-reported COPD, the number of cases for people aged 65 and above was projected to more than double between 2010 and 2036 from 0.04 million to 0.12 million, based on the effect of the demographic changes only. The estimated prevalence rate of COPD among older people in Hong Kong was far below the pooled estimate of

prevalence rate of 14.2% from studies around the world. The Hong Kong estimate was also lower than that in the US, the UK, Australia, China and Japan. Hong Kong has a relatively lower smoking prevalence compared to other countries, which might partly explain this finding. However, the self-reported data shown were likely to be under-estimated.

Based on spirometric data, the prevalence rate of COPD among those aged 60 and above varied from 12.4% to 25.9% depending on the diagnostic criteria. The Hong Kong findings were consistent with those reported in other countries, in which prevalence based on objective clinical tests was higher than the self-reported prevalence.



Chapter 4

Trends in COPD Incidence in Hong Kong

Chapter 4

Trends in COPD Incidence in Hong Kong

4.1 Introduction

Incidence, which reflects how fast new cases enter into the population, affects the prevalence. In this chapter, the incidence rate of COPD is examined. As with data on COPD prevalence, COPD incidence data are limited owing to the difficulty in defining the cases. In addition, conducting a cohort study on incidence of COPD is time-consuming and reliable information on incidence is rare.

4.2 Previous estimates of COPD incidence

In the PHS 2003/2004, respondents were asked if they had been diagnosed with COPD by a doctor and, if so, whether it had occurred in the 12 months prior to the survey. The collective responses estimated an annual incidence rate of 4.1 per 1,000 population for those aged 15 and above (Department of Health of Hong Kong SAR and Department of Community Medicine of HKU, 2005). Overall, incidence increased with age and the incidence rate of COPD among those aged 70 and above was 10.0 per 1,000 (Table 4.1).

Table 4.1 Annual incidence rates of COPD (per 1,000 population), by age group and sex, Hong Kong, 2003-2004

Age group	Male	Female	Both sexes
45-54	5.1	3.0	3.9
55-64	6.8	2.1	4.5
65-74	13.6	2.8	8.5
75+	27.2	5.1	14.0
Whole population (15+)	5.0	3.4	4.1

Data sources: Department of Health of Hong Kong SAR and Department of Community Medicine of HKU (2005) and authors' calculations

A cohort study of Chinese subjects aged 70 and above in 1991-1992 found that the incidence rate of self-reported doctor-diagnosed COPD was 31.0 per 1,000 population in a 36-month follow-up period (Ho *et al.*, unpublished data). This works out to an annual incidence rate of 10.3 per 1,000 population or 11.1 per 1,000 person-years.

To date, information on the local incidence of COPD remains scanty. Taking into account the differences in the definition and methodology of the above two studies, it appears that the incidence of COPD was relatively stable over the years.

4.3 Comparison of incidence with other countries

Owing to the differences in conceptualisation and compilation methods, international comparisons can only be conducted in a broad sense. Details about COPD incidence in individual countries are presented in subsequent sections.

4.3.1 United Kingdom

The estimated annual incidence rate of COPD among those aged 40 to 79 in the UK was 6.0 per 1,000 person-years in 1996-2001 (García Rodríguez *et al.*, 2008). Using spirometry, a cohort study in 12 European countries estimated the annual COPD ($FEV_1/FVC < 0.7$) incidence rate among those aged 40 to 45 to be 4.7 per 1,000 person-years in 1991-2002 (de Marco *et al.*, 2007).

4.3.2 Australia

The estimated incidence of COPD in Australia in 1996 was about the same as that in 2003 (Mathers, Vos & Stevenson, 1999; Begg *et al.*, 2007). In 2003, the estimated COPD incidence rate (per 1,000 population) was 1.2 and 0.9 in men and women, respectively. The incidence rate increased with age in both gender groups. The estimated incidence rate of COPD (per 1,000 population) among those aged 65 to 74 was 3.7 for men and 2.8 for women, while that among those aged 75 and above was 5.9 for men and 4.2 for women.

4.3.3 Japan

In Japan, the incidence rate of COPD ($FEV_1/FVC < 0.7$) based on spirometric data was estimated to be 6.4 per 1,000 person-years among population aged 25 to 74 in 1997-2005 (Kojima *et al.*, 2007). The incidence rate increased significantly with age. Incidence rate (per 1,000 person-years) among those aged 65 to 69 was 27.5 for men and 16.9 for women, whereas the rates among those aged 70 to 74 increased to 49.5 and 20.5, respectively.

4.4 Summary

There is limited information on the trend in COPD incidence not only in Hong Kong but also globally. The incidence of COPD in Hong Kong appeared to be stable over 1991 to 2004. This trend was consistent with the global and Australian estimates. The COPD incidence rate amongst those aged 70 and above in Hong Kong was about 10 per 1,000 population, which was lower than that in Japan but higher than that in Australia. Nevertheless, similar to the self-reported COPD prevalence data, self-reported COPD incidence data are subject to under-estimation.

Chapter 5

Trends in COPD Mortality in Hong Kong

Chapter 5

Trends in COPD Mortality in Hong Kong

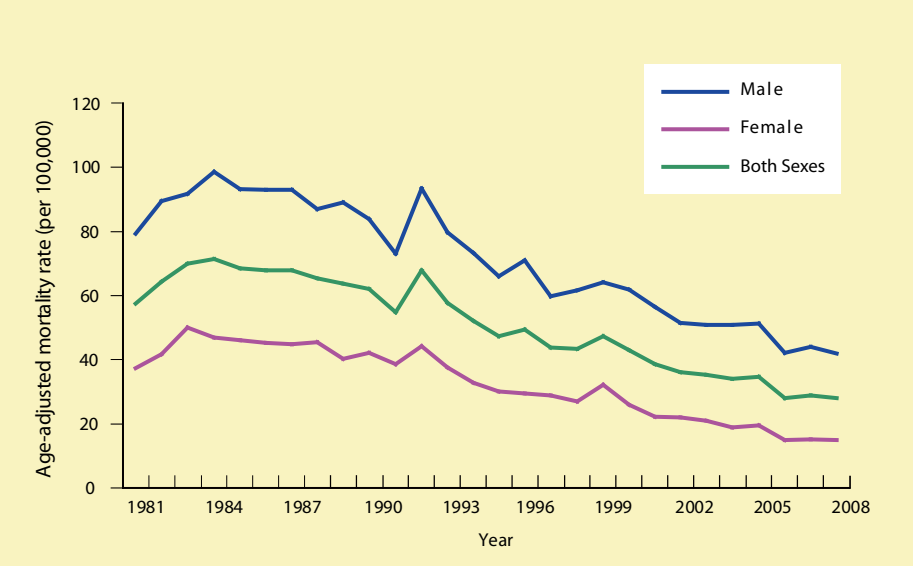
5.1 Introduction

Mortality, which reflects how fast cases leave the population, also affects the prevalence. In addition, premature mortality is a form of indirect costs. Other indirect costs include costs of dealing with disability and from unemployment. In this chapter, trends in COPD mortality are examined.

5.2 Mortality trends of COPD

In Hong Kong, COPD (ICD-9: 490-496 or ICD-10: J40-J47) has been the sixth leading cause of death in recent years, that is, ranked after external causes. In 2008, there were 2,103 deaths from COPD, accounting for 5.1% of all deaths (Centre for Health Protection, Department of Health of Hong Kong SAR, 2010). Retrospective analysis of the Department of Health mortality data for the period 1981-2008 showed the crude mortality rate of COPD (per 100,000) increased from 29.4 in 1981 to 43.0 in 1992, and then decreased to 30.1 in 2008. The age-adjusted COPD mortality rate increased slightly in the early 80s, then followed a decreasing trend in general, with the exception of a peak in 1992. (Figure 5.1) (Department of Health of Hong Kong SAR, 2010). The gender difference in mortality rate widened across the years. The rate ratio of mortality among men to women increased from around 2 to almost 3. COPD mortality rate in men followed the overall trend more closely, as compared to that in women where a smoother decrease in mortality rate was observed.

Figure 5.1 The age-adjusted* mortality rates for COPD (per 100,000), by sex, Hong Kong, 1981-2008



Data sources: Department of Health of Hong Kong SAR (2010) and authors' calculations
** Age-adjusted rate used the 2006 population as standard.*

Similar to the worldwide figures, the greatest number of deaths from COPD in Hong Kong occurs in those 65 years and above. In 1981, people aged 65 and above contributed to 70% of all COPD deaths and this proportion increased substantially to 94% in 2008. COPD mortality rate was shown to increase sharply with age (Table 5.1). The rate among those aged 65 and above was 211.9 per 100,000, accounting for 6.0% of all deaths within the age group in 2008. This rate was more than 100 times that in those aged below 65 (1.8 per 100,000).

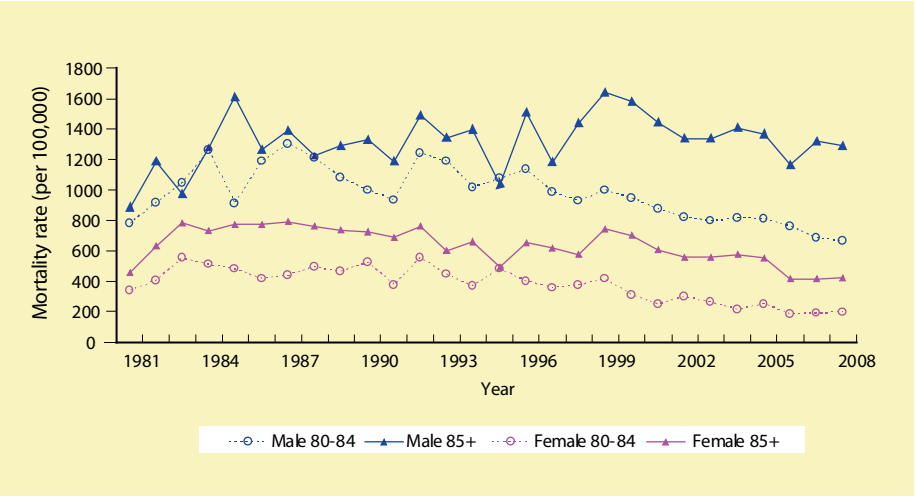
Table 5.1 COPD# mortality rates (per 100,000), by age group, Hong Kong, 1981-2008

Age group	1981	1985	1990	1995	2000	2005	2008
65-74	251.9	268.4	229.3	161.6	126.7	103.5	76.5
75-84	425.4	528.3	549.5	492.8	416.0	347.4	287.3
85+	548.8	949.8	871.7	645.2	963.6	805.3	692.9
0-64 (age-adjusted*)	12.3	12.4	9.5	5.9	3.4	2.4	1.8
65+ (age-adjusted*)	376.1	464.9	433.0	340.1	322.5	262.5	211.9
Whole Population (age-adjusted*)	57.5	68.6	62.1	47.4	43.1	34.7	27.9

 # Defined by ICD-9 as 490-496 for 1981-1999; ICD-10 J40-J47 for 2000-2008.
** Age-adjusted rate used the 2006 population as standard.*
Data sources: Department of Health of Hong Kong SAR (2010) and authors' calculations

The trend in age-specific COPD mortality among people aged 65 and above was similar to that in all age groups, except that the rate for the oldest male population (over 85 years) peaked in 1999; the rate (per 100,000) in this age/gender group rose from 885.7 in 1981 to 1,637.0 in 1999, then decreased to 1,287.5 in 2008.

Figure 5.2 Age-specific mortality rates for COPD (per 100,000), by age group and sex, Hong Kong, 1981-2008



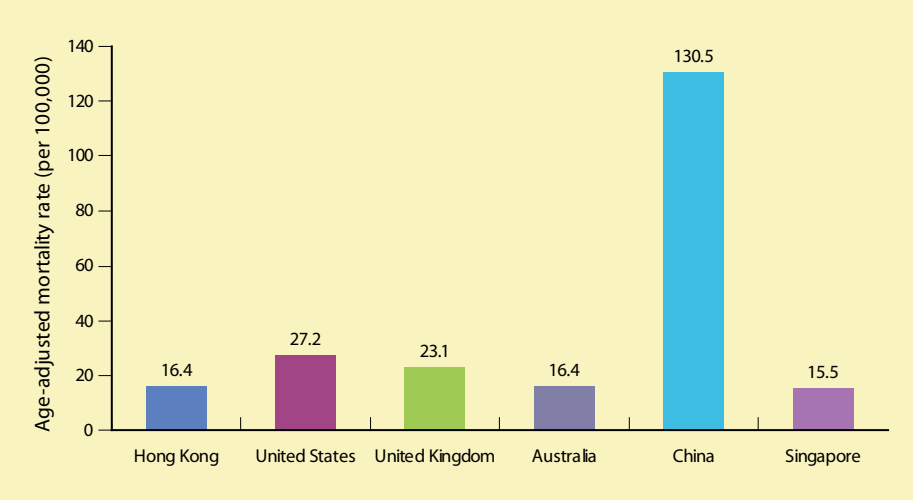
Data sources: Department of Health of Hong Kong SAR (2010) and authors' calculations

Although the prevalence trend of COPD remains uncertain in Hong Kong, the decline in mortality rate implies that the number of people living with the disease i.e. prevalence, is likely to increase.

5.3 Comparison of mortality with other countries

It was reported that the age-adjusted (standardised to mid-2002 world population) COPD mortality rate in Hong Kong was similar to that in Australia and Singapore, and was lower than that in the US, the UK and China (Figure 5.3) (Chan-Yeung *et al*., 2008).

Figure 5.3 Age-adjusted* mortality rates for COPD (per 100,000), by country, 2005



Data source: Chan-Yeung et al.(2008)
** Age-adjusted rate used the mid-2002 world population as standard.*

The trend in COPD mortality rate in Hong Kong is slightly different from that in other countries. Details about trends in individual countries are presented in subsequent sections.

5.3.1 United States

COPD has been the fourth leading cause of death in the US since 1990, accounting for about 5% of all deaths (National Center for Health Statistics, 2010; Xu *et al*., 2010). The age-adjusted COPD mortality rate (per 100,000) increased from 28.3 in 1980 to 41.8 in 1998 (ICD-9: 490-494, 496), and decreased from 45.4 in 1999 to 40.8 in 2007 (ICD-10: J40-J47). More than 85% of COPD deaths were among those 65 years and over. COPD mortality rate increased with age (Table 5.2). A rate of 596.1 per 100,000 was reported among those aged 85 and above in 2007.

Table 5.2 COPD# mortality rates (per 100,000), by age group, United States, 1999-2007

Age group	1999	2000	2001	2002	2003	2004	2005	2006	2007
65-74	177.2	169.4	167.9	163.0	163.2	153.8	160.5	149.3	148.1
75-84	397.8	386.1	379.8	386.7	383.0	366.7	385.6	363.4	368.9
85+	646.0	648.6	644.7	637.6	635.1	601.7	637.2	589.1	596.1
Whole Population (age-adjusted*)	45.4	44.2	43.7	43.5	43.3	41.1	43.2	40.5	40.8

 # Defined by ICD-10 as J40-J47.
** Age-adjusted rate used the US population in 2000 as standard.*
Data source: Xu et al. (2010)

Although the COPD mortality rate in women was lower than that in men, the difference was getting smaller (National Center for Health Statistics, 2010). Absolute number of deaths from COPD in women rose much quicker and levelled with that in men in 2000 (American Lung Association, 2010a).

5.3.2 United Kingdom

Approximately 29,500 deaths from COPD (ICD-10: J40-47) were recorded in the UK in 2007, accounting for about 5% of all deaths and the majority (90%) of these COPD deaths were reported in those aged 65 years and above (Office for National Statistics of UK, 2009b). The age-adjusted COPD mortality rate moderately declined in men but slightly increased in women during 1980 to 2003 (Devereux, 2006). In England and Wales, age-adjusted COPD mortality rate decreased in both men and women in recent years (Table 5.3) (Office for National Statistics of UK, 2005 and 2009a). The decline observed in men was largely seen in those aged 65 and above, whilst an increasing trend was observed in women aged 75 and above. Nevertheless, the rates tended to increase slightly in 2008.

Table 5.3 COPD# mortality rates (per 100,000), by age group and gender, England and Wales, 1999-2008

Age group	1999		2001		2003		2005		2007		2008	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
65-74	214.2	144.4	170.4	121.4	164.2	126.1	146.2	111.3	132.7	104.5	138.8	108.1
75-84	589.5	282.7	504.0	277.8	530.0	316.4	473.6	309.3	428.4	299.8	434.8	306.0
85+	1103.3	387.5	1072.7	394.5	1084.5	458.6	957.7	446.3	896.9	452.9	932.3	468.0
Whole population (age-adjusted*)	50.0	27.2	43.0	25.0	43.6	27.5	39.0	25.1	35.8	24.4	36.8	25.2

 # Defined by ICD-9 as 490-496 for 1999; ICD-10 J40-J47 from 2001 onwards.
** Age-adjusted rates used the European Standard Population as standard.*
Data sources: Office for National Statistics of UK (2005 and 2009a)

5.3.3 Australia

Age-adjusted COPD (ICD-10: J40-J47) mortality rate in Australia decreased from 38.1 per 100,000 in 1997 to 26.4 per 100,000 in 2008 (Table 5.4) (Australian Bureau of Statistics, 2010). Mortality rates increased sharply with age. In 2008, the mortality rate among those aged 65 to 74 was 78.0 per 100,000, accounting for 5% of all deaths within this group. The COPD mortality among those aged 65 and above decreased in men, but levelled off in women. However, despite the overall decreasing trend, mortality rate has increased in those aged 75 and above since 2007.

Table 5.4 COPD# mortality rates (per 100,000), by age group, Australia, 1997-2008

Age group	1997	1999	2001	2003	2005	2007	2008
65-74	149.8	130.0	116.1	94.5	82.2	74.1	78.0
75-84	337.4	309.0	279.6	276.8	234.0	239.9	257.9
85+	572.9	531.6	488.8	531.9	462.8	507.4	538.6
Whole population (age-adjusted*)	38.1	33.5	30.5	29.1	25.2	25.0	26.4

 # Defined by ICD-10 as J40-J47.
** The age-adjusted mortality rates used the Australian population as of 30 June, 2001 as standard.*
Data source: Australian Bureau of Statistics (2010)

5.3.4 China

Age-specific mortality data for COPD (ICD-10: J40-J47) in China became available after 2003. The crude mortality rate in urban areas decreased from 72.4 per 100,000 in 2003 to 43.6 per 100,000 in 2009, yet data on the trend in the 90s were unavailable (Table 5.5) (Ministry of Health of the People's Republic of China, 2010). Mortality rates increased sharply with age. In 2009, the rate among those aged 60 to 64 in urban areas was 28.7 per 100,000, but that in those aged 85 and above was 1,737.3 per 100,000. A higher mortality rate was reported to be much higher in men than women. Additionally, a higher rate was observed in rural areas as opposed to urban areas.

Table 5.5 COPD# mortality rates (per 100,000), by age group, China (urban areas), 2003-2009

Age group	2003	2006	2007	2008	2009
60-64	119.4	41.4	40.5	31.9	28.7
65-69	260.2	97.5	95.8	70.9	64.3
70-74	598.7	230.4	232.2	179.5	166.2
75-79	1,138.9	545.4	532.0	418.3	377.0
80-84	1,981.3	1,148.2	1,136.3	920.3	816.3
85+	2,972.4	2,370.3	2,265.6	1,822.7	1,737.3
Whole population	72.4	45.7	59.0	50.5	43.6

 # Defined by ICD-10 as J40-J47.
Data source: Ministry of Health of the People's Republic of China (2010)

Assuming that the exposure to risk factors such as tobacco smoke and solid-fuel use remains stable, it was projected that about 65 million of COPD deaths would occur in China between 2003 and 2033 (Lin *et al*., 2008). About 82% of these deaths would be attributable to the combined effects of smoking and solid-fuel use.

5.3.5 Singapore

In 1991-1998, COPD was the sixth leading cause of death in Singapore (Tan & Ng, 2008), accounting for 4.6% of all deaths. COPD (ICD-9: 491, 492, 496) mortality rate had decreased by 44% between 1991 and 1998 (Ng, Muhamad & Tan, 2004). Mortality rate increased substantially with age. In 1991-1998, the rate among those aged 65 to 74 was 154 per 100,000, whereas a much higher rate of 559 per 100,000 was reported in those aged 75 and above (Tan & Ng, 2008). Regrettably, data on recent mortality trends are unavailable.

5.3.6 Japan

COPD has become the tenth leading cause of death in Japan recently (Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare of Japan, 2010). The crude mortality rate for COPD (ICD-10: J41-J44) increased slightly from 9.6 per 100,000 in 1997 to 12.2 per 100,000 in 2009 (Table 5.6). Age-specific mortality rates have been declining, with the mortality rate in those aged 65 and above decreasing from 58.6 per 100,000 in 1997 to 51.6 per 100,000 in 2009.

Table 5.6 COPD# mortality rates (per 100,000), by age group, Japan, 1997-2009

Age group	1997	1999	2001	2003	2005	2007	2009
65-69	11.2	11.2	8.9	7.9	7.6	6.8	6.7
70-74	28.7	30.5	26.7	25.1	21.8	19.2	17.8
75-79	66.1	63.8	57.9	57.9	57.4	49.9	46.7
80-84	125.1	131.9	109.9	104.1	104.1	104.5	100.0
85+	215.3	208.0	204.4	193.5	184.2	178.9	170.1
Whole population	9.6	10.4	10.4	10.8	11.4	11.8	12.2

 # Defined by ICD-10 as J41-J44.
Data source: Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare of Japan (2010)

5.4 Summary

COPD is the sixth leading cause of death in Hong Kong. The age-adjusted COPD mortality rate in Hong Kong increased slightly in the early 80s, followed by a general reduction, with the exception of a peak in 1992. COPD mortality among people aged 65 and above followed a similar trend, with the proportion of deaths from this group increasing from 70% in 1981 to 94% in 2008. In 2008, the COPD mortality for those aged 65 and above was 211.9 per 100,000, accounting for 6.0% of all deaths within the age group. Age-adjusted COPD mortality rate in Hong Kong was similar to that in Australia and Singapore, and was lower than that in the US, the UK and China. The decreasing trend in recent years in Hong Kong was consistent with that in the US, the UK, Australia, China and Japan.

Chapter 6

Disability from COPD in Hong Kong

Chapter 6

Disability from COPD in Hong Kong

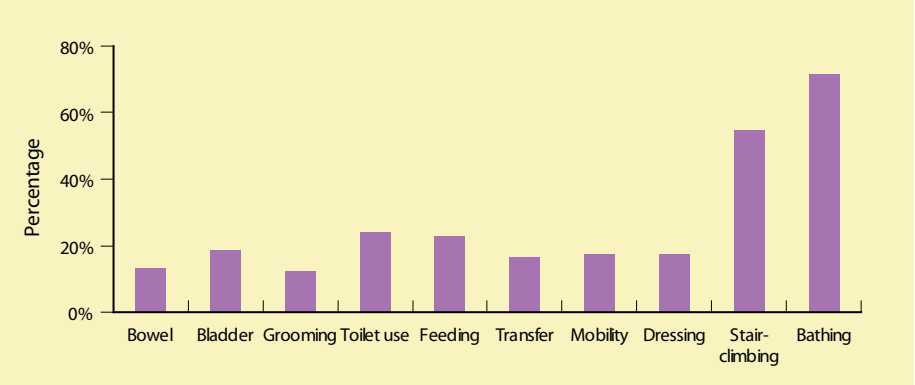
6.1 Introduction

COPD patients present with symptoms of respiratory failure such as shortness of breath, which can affect their ability to perform activities of daily living (ADL). Older COPD patients are more likely to have further restrictions in ADL. Cost in dealing with disability is one of the indirect costs to COPD. In the calculation of DALY, the disability weight estimated for mild and moderate symptomatic COPD was 0.17, and 0.53 for severe symptomatic COPD (Stouthard *et al.*, 1997). The disability weight for severe symptomatic COPD is even greater than that for ischaemic heart disease (Lopez *et al.*, 2006b), which reflects patients with severe COPD face a higher level of disability than those with ischaemic heart disease.

6.2 Functional limitations of COPD patients

In Hong Kong, a study investigated the functional limitations of COPD patients aged 65 and above with at least one episode of hospital readmission within the six months prior to the study. The majority of these older COPD patients had severe to very severe COPD (Lee, Lee & MacKenzie, 2006). The study reported a mean Barthel Index score of 16.65 (out of a maximum of 20) and 73.2% of these older COPD patients had mild to severe functional limitations as defined by the Barthel Index. In particular, 71.1% could not take a bath independently and 54.6% could not climb stairs independently (Figure 6.1).

Figure 6.1 Functional limitations (as defined by the Barthel Index) of COPD patients in Hong Kong



Data source: Lee, Lee & MacKenzie (2006)

In 1995, a study was conducted in population aged 18 and above attending a family clinic in Hong Kong. It showed that about 29% of the COPD (and asthmatic) patients had some extent of limitations in their daily activities (Lam & Lauder, 2000). Both COPD and asthma doubled the risk of limitations in daily activities (odds ratio=2.2), after adjusting for their differences in demographics and co-existing chronic diseases.

6.3 Comparison of functional limitations of COPD patients with other studies

Functional limitations of COPD patients were also observed in overseas studies. An Italian study showed that COPD patients aged 65 and above had significantly more functional limitations as reflected by a lower Barthel Index score (Peruzza *et al.*, 2003). The mean Barthel Index score for COPD patients was 89.7 (out of a maximum of 100), whereas that for healthy subjects was 94.2.

A survey conducted in the US in 2000 showed that half (51%) of all COPD patients aged 45 and above reported some extent of work limitations (Schulman, Ronca and Bucuvalas, Inc., 2001). It also showed that COPD patients had limitations in normal physical exertion (70%), lifestyle (58%), household chores (56%), social activities (53%) and sleeping (50%). In addition, 72% of COPD patients experienced breathlessness when walking up one flight of stairs and 44-46% had shortness of breath when doing light housework, washing or dressing.

In Singapore, it was estimated that about 11.6% of Chinese COPD patients aged 55 and above had functional disability (needing help in one or more of the ten selected basic ADL), as compared to 5.5% among those without COPD (Ng *et al.*, 2009).

6.4 Summary

About 73.2% of the COPD patients aged 65 and above in Hong Kong had mild to severe functional limitations as defined by the Barthel Index. Over half of the older people with COPD reported difficulty in bathing (71.1%) and stair-climbing (54.6%). Similar functional limitations among COPD patients were observed in overseas studies.

Chapter 7

COPD and Health-Related Quality of Life in Hong Kong

Chapter 7

COPD and Health-Related Quality of Life in Hong Kong

7.1 Introdution

Health-Related Quality of Life (HRQoL) refers to patients' perceptions of the impact of the disease and treatment on their physical, psychological and social functioning and wellbeing, which is crucial in the evaluation of health care interventions. HRQoL in COPD patients is substantially worse than that in the general population.

Simple measures of HRQoL include self-rated health and depressive symptoms. A variety of instruments are used to measure HRQoL including the Medical Outcomes Study short form 36 (SF-36) and short form 12 (SF-12) which are widely used in Hong Kong. The physical component summary identifies impacts on the physical aspects of HRQoL and the mental component summary measures impacts on the mental aspects.

7.2 Self-rated health of COPD patients

We used the EHC cohort data to examine the impact of COPD on self-rated health. Table 7.1 shows that EHC enrolees (aged 65 and above) who reported they were receiving regular care for COPD were more likely to report poorer health (16.4%) than those without COPD (7.2%) (p-value < 0.001).

Table 7.1 Self-rated health status of people aged 65 and above in EHC cohort, by COPD# status, 1998-2001

	Self-rated health compared with others of the same age N (%)			
COPD status at enrolment	**Better**	**Normal**	**Worse**	**Total**
Known COPD (having regular care)	406	1,582	389	2,377
	(17.1%)	(66.6%)	(16.4%)	(100%)
No COPD	15,139	43,358	4,571	63,068
	(24.0%)	(68.7%)	(7.2%)	(100%)
Total	15,545	44,940	4,960	65,445
	(23.8%)	(68.7%)	(7.6%)	(100%)

 # Exact phrase used in the questionnaire was "COAD".
Data sources: Data from EHC of Department of Health of Hong Kong SAR and authors' calculations

7.3 Depressive symptoms of COPD patients in Hong Kong

The EHC cohort data also showed that among people aged 65 and above who had regular care for COPD, 15.0% had depressive symptoms (Geriatric Depression Scale (GDS) ≥ 8) compared to 9.3% among those without COPD (p-value < 0.001) (Table 7.2).

Table 7.2 Depression status of people aged 65 and above in EHC cohort, by COPD status#, 1998-2001

	Depression Status N(%)		
COPD status at enrolment	**GDS* < 8**	**GDS* ≥ 8**	**Total**
Known COPD (having regular care)	2,020	356	2,376
	(85.0 %)	(15.0%)	(100.0%)
No COPD	57,154	5,860	63,014
	(90.7 %)	(9.3%)	(100.0%)
Overall	59,174	6,216	65,390
	(90.5%)	(9.5 %)	(100.0%)

 # Exact phrase used in the questionnaire was "COAD".
** GDS short-form scale (Range 0-15) ≥ 8 indicates depressive symptoms.*
Data sources: Data from EHC of Department of Health of Hong Kong SAR and authors' calculations

A study on two cohorts of older people aged 65 years and above showed that about 13.2% of subjects with chronic respiratory diseases had depressive symptoms (GDS ≥ 8) as compared to 9.0% among those without (Wong *et al*., 2006). The odds ratio of having depression was estimated to be 1.52 (95% CI: 1.08-2.14).

7.4 SF-12 scores of COPD patients in Hong Kong

We examined SF-12 scores among people aged 65 and above with COPD in Hong Kong using a sub-sample from the EHC cohort. Based on EHC cohort as at the end of 2005, a sample stratified by smoking status was interviewed by telephone between 2006 and 2007. The sampling procedures were reported elsewhere (Ma, 2008). Among the 2,441 subjects who completed the SF-12 questionnaire, 156 reported that they had known COPD.

The Chinese (HK) version of SF-12 questionnaire, which is validated for use in Hong Kong, was adopted and administered in Cantonese (Ware, Kosinski & Keller, 1995; Lam, Tse & Gandek, 2005). It measures HRQoL using the physical component score (PCS) and mental component score (MCS), which are constructed using the answers to 12 questions over 8 domains of quality of life. Scoring was based on the US algorithm for comparability with US studies, with both scores ranging from 0 to 100 and that a higher score indicates a better HRQoL (and vice versa).

The mean PCS score for those with COPD was 34.3 which was lower than the average score for those without COPD (40.7) (p-value < 0.001). The MCS score for those with COPD was also lower (49.0) than that for those without COPD (51.7) (p-value = 0.0015) (Table 7.3).

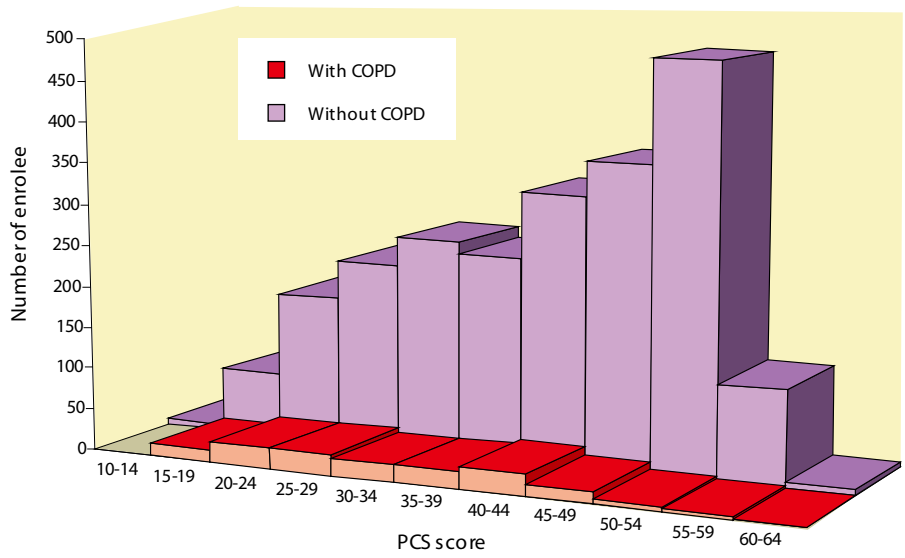
Table 7.3 Comparison of SF-12 scores between population aged 65 and above, by COPD status#, 2006-2007

COPD status at enrolment	N	PCS Mean[a]	MCS Mean[b]
With COPD	156	34.3	49.0
Without COPD	2,285	40.7	51.7
Total Population	2,441	40.3	51.5

 # Exact phrase used in the questionnaire was "COAD".
a: 2-sample t-test for the PCS mean of the groups with and without COPD, p-value < 0.001
b: 2-sample t-test for the MCS mean of the groups with and without COPD, p-value = 0.0015
Data sources: Data from EHC of Department of Health of Hong Kong SAR and authors' calculations

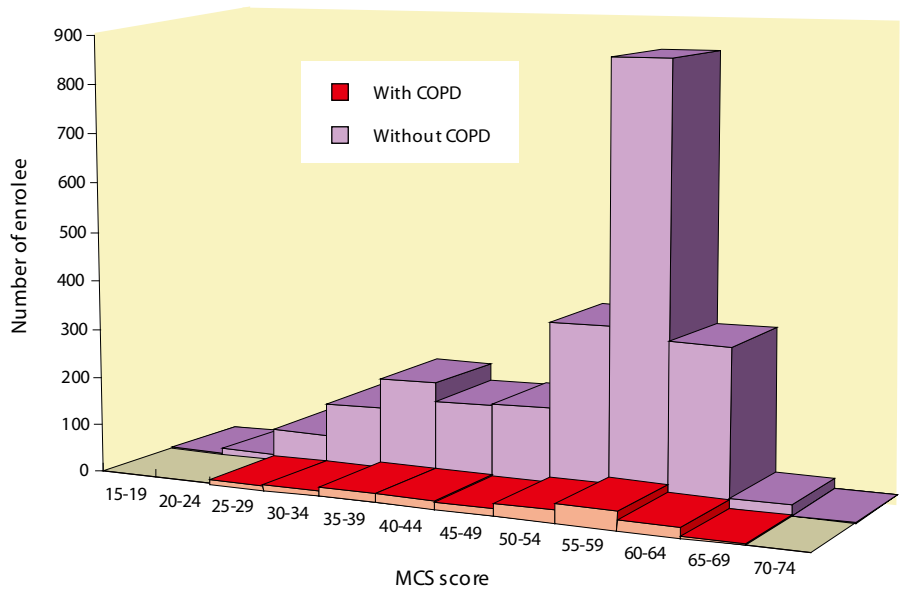
Figure 7.1a shows that the PCS scores for older people with COPD tend to cluster at the lower end, whereas scores for those without COPD tends to cluster at the upper end. Although the MCS scores for those with COPD are not skewed (Figure 7.1b), older people without COPD tends to have higher scores. This suggests people without COPD tend to score higher in both PCS and MCS scores.

Figure 7.1a Distribution of SF-12 PCS scores among the population aged 65 and above, by COPD status, 2006-2007



Data sources: Data from EHC of Department of Health of Hong Kong SAR and authors' calculations

Figure 7.1b Distribution of SF-12 MCS scores among the population aged 65 and above, by COPD status, 2006-2007



Data sources: Data from EHC of Department of Health of Hong Kong SAR and authors' calculations

7.5 Comparison of HRQoL of COPD patients with other studies

Evidence of association between HRQoL and COPD was identified in various overseas studies. A study conducted in the US in 2006 showed that about 14.7% of COPD patients aged 55 to 75 rated their health as poor and 25.0% rated their health as fair (Katz *et al*., 2009). Another US study estimated that about 27.5% of COPD patients aged 40 to 65 had depressive symptoms (GDS ≥ 6), as compared to only 5.6% among those without (Omachi *et al*., 2009). Additionally, people with greater COPD severity was found to be more likely to have depressive symptoms, even after adjusting for their differences in demographics and the co-existing diseases.

In Singapore, it was estimated that about 22.8% of the Chinese COPD patients aged 55 and above had depressive symptoms (GDS ≥ 5), as compared to 12.4% among those without COPD (Ng *et al*., 2009). The odds ratio after adjusting for known risk factors was estimated to be 1.86 (95% CI: 1.25-2.75). About 43.9% of the subjects with COPD reported their health as fair or poor, whereas only 31.8% of those without COPD did. It was also shown that depressed COPD patients were more likely to have limitations in ADL, poorer self-rated health, and lower PCS and MCS scores.

Several overseas studies have used SF-12 or SF-36 to measure HRQoL. In Singapore, both the SF-12 PCS and MCS scores of the Chinese COPD patients aged 55 and above clustered at the lowest tertile (Ng *et al*., 2009). A study conducted in Norway showed that both the SF-12 PCS and the MCS scores declined significantly with an increasing number of respiratory symptoms (Voll-Aanerud *et al*., 2008). Associations between the progressing GOLD stages of COPD severity and declining PCS scores were identified, although the decline in MCS scores was insignificant (Ståhl *et al*., 2005; Voll-Aanerud *et al*., 2008). It should be noted that patients who were at a mild stage of COPD still showed decline in HRQoL (Carrasco Garrido *et al*., 2006).

7.6 Summary

Older people living with COPD in Hong Kong reported a relatively worse HRQoL in terms of physical and mental health as measured by SF-12. COPD patients aged 65 and above in Hong Kong also had poorer self-rated health and were more likely to have depressive symptoms when compared to those without COPD. These observations in Hong Kong were similar to studies conducted in other places.

Chapter 8

Service Utilisation Arising from COPD in Hong Kong

Chapter 8

Service Utilisation Arising from COPD in Hong Kong

8.1 Introduction

COPD patients often have frequent admissions to hospital. One of the reasons for hospitalisation is acute exacerbations of COPD. In 2001, among people aged above 65 years, COPD ranked first in terms of number of public hospital episodes (30,530 episodes). Patients aged 65 years and above diagnosed with COPD occupied 238,022 bed days and there were 11,336 COPD patients who stayed in public hospitals (Disease Prevention and Control Division and Elderly Health Services, Department of Health of Hong Kong SAR, 2004). About 94% of the COPD hospital episodes arose in public hospitals monitored by Hospital Authority (HA) (HA of Hong Kong SAR, 2010). We analysed the data of discharges from public hospitals between 1997 and 2006, restricting to discharges coded with a primary diagnosis of COPD (ICD-9: 490-496) and only two age groups (under and above 65 years).

8.2 Number of COPD hospital episodes

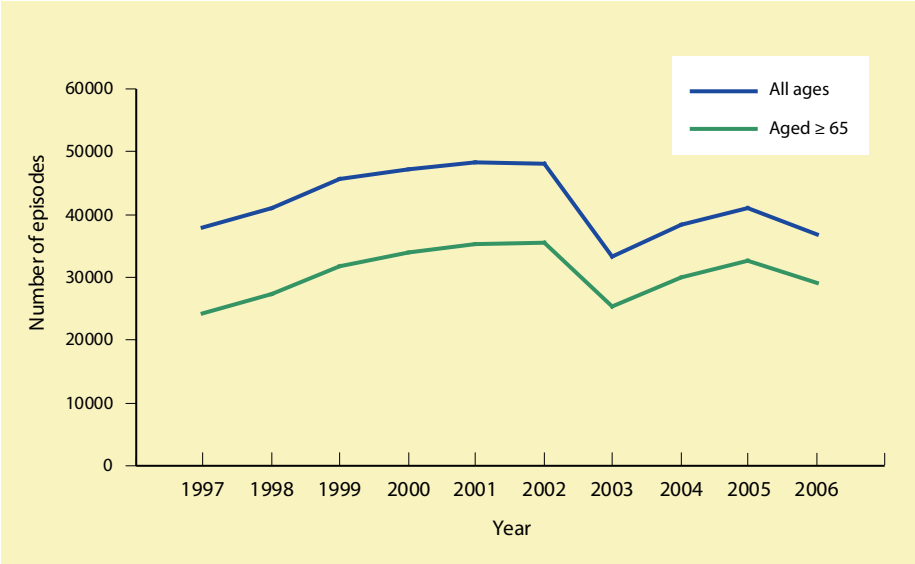
In Hong Kong, episodes with a primary diagnosis of COPD accounted for around 4% of all hospital episodes. Table 8.1 shows the number of COPD episodes in 1997 to 2006. Most episodes were from those aged over 65 years and this proportion increased from 64% in 1997 to 80% in 2006. The proportion of episodes for those aged 80 years and above increased much faster, rising from 18% in 1997 to 34% in 2006. The number of COPD episodes fluctuated on a yearly basis, with an increasing trend from 1997-2002, a sharp decrease in 2003, followed by an increasing trend until 2005. While the number among the patients aged 65 and above went down in 2006, it was still well above the value in 1997 (Figure 8.1). It was noted that the drop in 2003 might be due to the outbreak of severe acute respiratory syndrome (SARS) in Hong Kong in 2003 (Ko *et al*., 2007).

Table 8.1 Annual number of episodes of COPD# in Hong Kong public hospitals, 1997-2006

Year	Episodes of COPD (% among all episodes)	Episodes for COPD patients aged 65+ (% among all COPD episodes)
1997	38,000 (3.9)	24,000 (64.2)
1998	41,000 (4.0)	27,000 (67.1)
1999	46,000 (4.2)	32,000 (69.8)
2000	47,000 (4.1)	34,000 (71.7)
2001	48,000 (4.0)	35,000 (73.0)
2002	48,000 (4.0)	35,000 (73.9)
2003	33,000 (3.3)	25,000 (76.2)
2004	38,000 (3.5)	30,000 (78.4)
2005	41,000 (3.6)	33,000 (79.4)
2006	37,000 (3.2)	29,000 (79.8)

 # Defined by ICD-9 as 490-496.
Note: Percentages are based on figures before rounding.
Data sources: HA hospital discharge statistics and authors' calculations

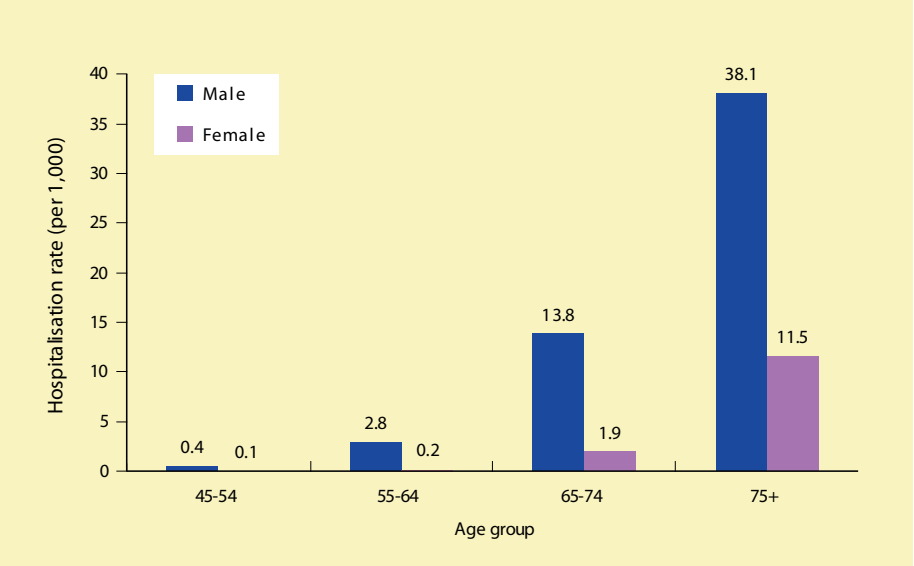
Figure 8.1 Annual number of episodes of COPD# in Hong Kong public hospitals, 1997-2006



 # Defined by ICD-9 as 490-496.
Data sources: HA hospital discharge statistics and authors' calculations

A similar trend was observed in another study which showed that the age-adjusted hospitalisation rates of COPD (ICD-9: 490-492, 496) remained stable in 1997 to 2002, followed by a drop in 2003, and increased in 2004 and 2005 (Chan-Yeung *et al*., 2008). The overall decreasing trend over 1997 to 2005 was statistically significant. Women showed a significant decreasing trend, while men did not. Men had much higher COPD hospitalisation rates than women (Figure 8.2). In 2005, the COPD hospitalisation rate (per 1,000) for men aged 65 to 74 was 13.8, while that for women was only 1.9.

Figure 8.2 Age-specific hospitalisation rates (per 1,000) of COPD#, Hong Kong, 2005



 # Defined by ICD-9 as 490-492 and 496.
Data source: Chan-Yeung et al.(2008)

It should be noted that the admission data used only included episodes with a primary diagnosis of COPD. Many hospital admissions have COPD as a secondary diagnosis or co-morbidity, which might increase the severity of the primary illness and/or the burden of care.

8.3 Number of bed days for COPD patients

Table 8.2 shows the annual number of bed days in hospital for patients admitted with a primary diagnosis of COPD between 1997 and 2006. More than 4% of the annual bed days were used by COPD patients and those aged 65 years used the majority (over 80%) of bed days. The trend followed closely with the number of COPD episodes.

Table 8.2 Annual number of bed days (in days) for patients with a primary diagnosis of COPD# in Hong Kong public hospitals, 1997-2006

Year	Number of bed days of all COPD patients (% among all patients)	Number of bed days of COPD patients aged 65+ (% among all COPD patients)
1997	278,000 (3.9)	210,000 (75.4)
1998	310,000 (4.1)	242,000 (78.0)
1999	330,000 (4.3)	264,000 (79.8)
2000	338,000 (4.5)	273,000 (80.8)
2001	328,000 (4.4)	267,000 (81.4)
2002	324,000 (4.4)	270,000 (83.3)
2003	229,000 (3.6)	190,000 (82.6)
2004	282,000 (4.4)	242,000 (85.9)
2005	299,000 (4.7)	256,000 (85.5)
2006	258,000 (4.3)	223,000 (86.4)

 # Defined by ICD-9 as 490-496.
Note: Percentages are based on figures before rounding.
Data sources: HA hospital discharge statistics and authors' calculations

The average number of bed days per episode slightly decreased from 7.4 days in 1997 to 7.0 days in 2006. Older COPD patients had more bed days than the younger ones. Those aged 65 and above spent more than a week (7.6 days in 2006) in hospital per episode, or a total of 2 to 3 weeks a year (17.8 days in 2006) (Table 8.3).

Table 8.3 Average number of bed days of COPD# patients in Hong Kong public hospitals, 1997-2006

Year	Number of bed days per episode (in days)		Number of bed days per patient per year (in days)	
	All ages	Aged 65+	All ages	Aged 65+
1997	7.4	8.7	14.2	19.3
1998	7.6	8.8	15.0	20.4
1999	7.2	8.3	15.1	20.1
2000	7.1	8.1	15.5	20.1
2001	6.8	7.6	15.2	19.7
2002	6.8	7.6	15.5	20.2
2003	6.9	7.5	14.4	17.3
2004	7.4	8.1	15.9	19.0
2005	7.3	7.8	15.5	18.4
2006	7.0	7.6	14.9	17.8

 # Defined by ICD-9 as 490-496.
Data sources: HA hospital discharge statistics and authors' calculations

8.4 Comparison of hospital admissions with other countries

The absolute numbers of hospital admissions could not be compared among countries, although it was clear that most of the hospitalisation occurred in older patients. Several studies have estimated this health care utilisation.

8.4.1 United States

About 8.5% of all hospital episodes among those aged 25 and above had either a primary or secondary diagnosis of COPD in the US in 1979-2001 (Holguin *et al*., 2005). Of these episodes, more than 20% had COPD as the primary diagnosis. The rate of hospital discharges with COPD as the principal diagnosis increased from 1.7 per 1,000 in 1992 to 2.3 per 1,000 in 2006 (American Lung Association, 2010b). Hospitalisation rates for COPD increased in all age groups until 1999, after which the rate declined slightly in 2000 and has remained stable. The largest increase was observed in those aged 65 and above (Table 8.4). In 2006, about 64% of COPD hospital episodes were reported in the population aged 65 and above, with the COPD hospitalisation rate being approximately 11.6 per 1,000.

Table 8.4 Hospitalisation rates (per 1,000) for COPD, by age group, United States, 1992-2006

Age group	1992	1995	1998	2001	2004	2006
45-65	2.3	2.9	3.2	2.7	2.7	2.8
65+	8.6	11.1	13.3	13.0	11.4	11.6
Whole population	1.7	2.1	2.5	2.3	2.2	2.3

Data source: American Lung Association (2010b)

8.4.2 United Kingdom

In England, hospitalisation rates for COPD as a primary diagnosis increased across all age groups between 1991 and 2000 (Lung & Asthma Information Agency, 2003). Men and women followed similar trends, although an increase in the hospitalisation rate was slightly greater in women than in men.

Both the number of hospital admissions and finished consultant episodes for COPD (ICD-10: J40-J47) increased during 1998 to 2009 in all ages (Hospital Episode Statistics, The Information Centre, NHS of UK, 2009). The mean length of stay in hospital increased from 7.5 days in 1998/1999 to 7.8 days in 2002/2003, followed by a reduction to 5.9 days in 2008/2009. Over 60% of the COPD finished consultant episodes were for people aged 60 and above (Table 8.5).

Table 8.5 Number of finished consultant episodes for COPD#, by age group, England, 1998-2009

Year	Aged 15-59	Aged 60+	Whole Population	Proportion of episodes for those aged 60+ among episodes for all ages
1998/1999	53,698	134,953	221,367	61.0%
1999/2000	53,259	137,758	221,736	62.1%
2000/2001	51,524	135,108	213,881	63.2%
2001/2002	52,253	142,701	223,657	63.8%
2002/2003	54,904	149,419	229,725	65.0%
2003/2004	61,777	173,563	260,677	66.6%
2004/2005	67,586	178,277	275,194	64.8%
2005/2006	66,882	179,195	271,935	65.9%
2006/2007	69,334	178,779	278,695	64.1%
2007/2008	66,035	176,115	268,268	65.6%
2008/2009	73,889	198,465	301,841	65.8%

 # Defined by ICD-10 as J40-J47.
Data source: Hospital Episode Statistics, The Information Centre, NHS of UK (2009)

8.4.3 Australia

Hospitalisation (defined as separations) for COPD (ICD-10: J40-J47) as a primary diagnosis accounted for 1.5% of all separations in Australia from 1998 to 2008 (Australian Institute of Health and Welfare, 2009). The number of hospitalisations increased during this period among those aged 65 and above, but either remained stable or decreased in the younger age groups (Table 8.6). Males and females had similar trends over the period. Almost half (increased from 41% in 1998/1999 to 51% in 2007/2008) of the hospitalisation for COPD was among those aged 65 and above, whereas in terms of patient days, such proportion ranged from 64% to 71% in 1998 to 2008. The number of patient days per episode (separation) was relatively stable at about 5 days throughout this ten-year period and older people were found to require more patient days. On average, the number of patient days in hospital per episode for the COPD patients aged 65 and above decreased from 8.2 days in 1998/1999 to 7.2 days in 2007/2008.

Table 8.6 Number of hospitalisations for COPD#, by age group, Australia, 1998-2008

Year	Aged 35-49	Aged 50-64	Aged 65+	Whole Population	Proportion of episodes for those aged 65+
1998/1999	7,504	15,211	43,666	107,023	40.8%
1999/2000	7,607	15,500	45,071	101,655	44.3%
2000/2001	7,311	15,539	46,536	105,775	44.0%
2001/2002	6,835	15,311	46,965	98,375	47.7%
2002/2003	6,171	15,173	48,995	96,837	50.6%
2003/2004	6,282	15,291	49,488	98,545	50.2%
2004/2005	6,270	15,631	47,741	96,836	49.3%
2005/2006	6,523	15,397	48,420	98,043	49.4%
2006/2007	6,332	14,881	47,291	95,580	49.5%
2007/2008	6,856	15,850	51,224	101,466	50.5%

 # Defined by ICD-10 as J40-J47.
Data source: Australian Institute of Health and Welfare (2009)

Weighted to the world population, the average hospitalisation rate among people aged 40 and above in Australia was 4.8 per 1,000 in 1991-2004, which was only half of that in Hong Kong (8.7 per 1,000) (Tan *et al*., 2009).

8.4.4 China

In urban areas in China, the hospital discharge rate for COPD (ICD-10: J40-J44) was stable between 1993 and 2008, besides a drop in 2003. The rate was 1.5 per 1,000 in 2008 (Table 8.7) (Ministry of Health of the People's Republic of China, 2010). Meanwhile, such rate increased rapidly in rural areas. The number of hospital discharges of COPD cases nearly doubled from 173,248 in 2006 to 337,781 in 2008. The older population aged 60 and above accounted for about 70% of all COPD hospital discharges. The length of hospital stay was longer for those in urban areas than in rural areas. The average length of stay in hospital for COPD patients was 11.2 days (10.2 days if rural areas were included) in 2008.

Table 8.7 Rates of hospitalisation (per 1,000) for COPD#, by urban and rural areas, China, 1993-200

Year	Urban areas	Rural areas	Total
1993	1.3	0.6	0.7
1998	1.4	0.8	1.0
2003	0.9	0.5	0.6
2008	1.5	1.6	1.6

 # Defined by ICD-10 as J40-J44.
Data source: Ministry of Health of the People's Republic of China (2010)

8.5 Summary

In Hong Kong, hospital episodes with a primary diagnosis of COPD accounted for 4% of all episodes and bed days in public hospitals. Most episodes were utilised by those over 65 years old and this proportion increased from 64% in 1997 to 80% in 2006. The number of COPD episodes among those aged 65 and above fluctuated on a yearly basis. The age-adjusted hospitalisation rates remained stable in 1997 to 2002, followed by a drop in 2003, and subsequently increased in 2004 and 2005. In 2005, the COPD hospitalisation rate (per 1,000) for men aged 65 to 74 was 13.8, whereas that for women was only 1.9. On average, the COPD patients aged 65 and above with hospitalisation spent more than a week in hospital per episode, or a total of 2 to 3 weeks a year.

The proportion of COPD hospitalisation for older people (aged 65 and above) was higher in Hong Kong when compared with the US, the UK, Australia and China. The COPD hospitalisation rate in Hong Kong was higher than that in Australia, even after adjustment for age differences. The average number of bed days in hospital per episode by older COPD patients in Hong Kong was similar to that in Australia.

Chapter 9

Economic Burden from COPD in Hong Kong

Chapter 9

Economic Burden from COPD in Hong Kong

9.1 Introduction

COPD patients as well as the society at large have to bear the costs of COPD. Direct costs include costs of hospital admissions, doctor visits, emergency care and community care services, together with the costs of long-term medication for COPD patients. Indirect costs include loss of productivity of the patients and caregivers. Statistics on indirect costs of COPD are sparse in Hong Kong. Since the official retirement age in Hong Kong is 65 years for many people, productivity loss is not a significant addition to the costs in this age group. Owing to limited data, we could only estimate costs of hospital admissions here. In this chapter, we will examine one of the major direct costs of COPD — costs of hospital admissions.

9.2 Costs of COPD–related hospital admissions

9.2.1 Annual costs

Data on hospital admissions to the public hospitals were provided by the HA. COPD-related bed days are defined as those admitted with a primary diagnosis of COPD (ICD-9: 490-496). Number of bed days for each episode was generated from admission and discharge dates. To include only the hospital utilisation in the calendar year of 2006, a date of admission on or before 31 Dec 2005 was replaced by 1 Jan 2006 and a discharge in 2007 by 31 Dec 2006. The standard public ward fee (i.e. a cost recovery charge) of HK$3,300 per day was adopted to evaluate hospital resources used by COPD patients in 2006 ("Special Supplement No.4 to Gazette No. 13/2003", 2003).

There were 298,444 COPD-related bed days being utilised in public hospitals in Hong Kong in 2006. The corresponding costs of these bed days were approximately HK$985 million (US$127 million). About 86% of these bed days were used by people over 65 years old with a value of HK$844 million (US$109 million). On average, the annual cost of hospital admissions incurred for each COPD patient (all ages) was approximately HK$56,051 (US$7,216), whereas the cost for an older patient was higher (HK$66,287 or US$8,533) (Table 9.1).

Table 9.1 Annual costs of COPD hospitalisation in Hong Kong, 2006

Age group	Bed days	Standard costs	Annual costs	Annual costs per patient
All ages	298,444	HK$3,300	HK$984,865,200	HK$56,051
65+	255,808	HK$3,300	HK$844,166,400	HK$66,287

Data sources: HA hospital discharge statistics and authors' calculations

The above figures could be under-estimated since they did not include patients admitted to private hospitals (which accounted for about 6% of all COPD episodes), those with COPD as a second or subsequent diagnosis but whose extended hospital stay could be due to COPD, and those who had not been diagnosed with COPD.

In Section 3.3, we projected that there would be about 0.04 million people aged 65 and above in Hong Kong with known COPD in 2010 and 0.12 million in 2036. Using the cost figures in 2006, we estimated that COPD hospitalisation costs in the public sector for older COPD patients would be HK$3.0 billion (US$ 0.4 billion) in 2010 and HK$7.8 billion (US$ 1.0 billion) in 2036 (Table 9.2).

Table 9.2 Estimated COPD hospitalisation costs in the public sector for COPD patients aged 65 and above in Hong Kong, 2010 and 2036

Aged 65+	2010	2036
Annual COPD hospitalisation costs per capita	HK$ 66,287	HK$ 66,287
Estimated number with known COPD	44,718	117,112
Estimated COPD hospitalisation costs in public sectors (at 2006 price)	HK$ 3.0 billion	HK$ 7.8 billion

Data source: Authors' calculations

9.2.2 Costs of COPD–related hospital admissions by severity

Some COPD patients develop respiratory failure and have to rely on advanced life support systems, which inevitably require more medical resources (Ip, 2001). The costs of treating severe COPD are much higher than that for mild and moderate cases in terms of direct costs i.e. health care and medication costs. One hospital in Hong Kong carried out a costing of COPD in year 1998/1999 by disease severity, and results are shown in Table 9.3 (unpublished data).

Table 9.3 Annual costs of COPD (data from one hospital), by disease severity, Hong Kong, 1998/1999

	COPD severity	
Average costs	**Moderate**	**Severe**
Average costs per discharge	HK$13,000 (US$1,680)	HK$100,000 (US$12,910)
Average costs per patient per year	HK$24,000 (US$3,100)	HK$102,000 (US$13,170)
Average costs per bed day	HK$2,000 (US$260)	HK$5,000 (US$650)

Data source: Unpublished data

There is a large difference in the costs of managing moderate and severe COPD patients, managing severe patients could be 3 to 8 times as costly as managing moderate cases. This implies that preventing patients from moving to a severe state from a moderate state is worthwhile in order to reduce costs and improve patients' quality of life.

9.2.3 Smoking-attributable costs of COPD

As a major risk factor of COPD, smoking significantly contributes to the overall costs of COPD management in Hong Kong. In 1998, the smoking-attributable public hospital costs of COPD in the population aged 35 and above were estimated to be HK$430 million (US$56 million), accounting for one-third of all tobacco-related diseases (McGhee *et al*., 2005). The majority of the costs were utilised for treating patients aged 65 years and over, particularly males (Table 9.4).

Table 9.4 Smoking-attributable costs of public hospital care for COPD, Hong Kong, 1998

Age group	Male	Female	Total
35-64	HK$51,548,000 (US$6,656,000)	HK$3,872,000 (US$500,000)	HK$55,420,000 (US$7,156,000)
65+	HK$278,325,000 (US$35,936,000)	HK$96,750,000 (US$12,492,000)	HK$375,076,000 (US$48,428,000)
Whole Population (35+)	HK$329,874,000 (US$42,592,000)	HK$100,623,000 (US$12,992,000)	HK$430,496,000 (US$55,584,000)

Note: Individual cells may not sum up to total due to rounding.
Data source: McGhee et al. (2005)

9.3 Comparison of costs of COPD with other countries

Studies from other countries reporting estimated costs of COPD varied in terms of inclusion criteria and calculation methods. Therefore, these data should be used with caution and only as a rough guide to costs in each country.

9.3.1 United States

In the US, direct costs accounted for more than 60% of the total economic costs of COPD (excluding asthma) in 2007 (National Heart, Lung, and Blood Institute, and National Institutes of Health, Department of Health and Human Services of US, 2007). The costs of managing COPD in the US were estimated at approximately US$42.6 billion, of which US$26.7 billion was used for direct health care expenditures, US$8.0 billion for indirect costs of morbidity i.e. productivity lost due to illness and US$7.9 billion for indirect costs of mortality i.e. productivity lost due to premature death. Direct and indirect costs of mortality were projected to increase to US$49.9 billion in 2010, of which US$29.5 billion were allocated for direct costs and US$12.4 billion for indirect costs of mortality. Indirect costs of morbidity would remain at US$8.0 billion (National Heart, Lung, and Blood Institute, and National Institutes of Health, Department of Health and Human Services of US, 2009). The Confronting COPD survey estimated that the mean annual direct costs per patient were US$4,119 (Wouters, 2003).

Medical costs were higher and the proportion of hospitalisation costs increased when COPD progressed to a more severe stage (Table 9.5) (Hilleman *et al.*, 2000). In addition, costs for oxygen therapy also increased dramatically for more severe cases (from US$699 to US$2,012 for Stage II/ III COPD as defined by American Thoracic Society staging system).

Table 9.5 Annual median treatment costs per COPD (excluding asthma) patient aged 35 to 80, by severity, United States, 1993-1994

COPD severity*	Total costs§	Hospitalisation costs	% of hospitalisation costs
Stage I (0.50 ≤ FEV_1 ≤ 0.65 predicted)	US$1,681	US$680	40%
Stage II (0.35 ≤ FEV_1 ≤ 0.5 predicted)	US$5,037	US$2,658	53%
Stage III (FEV_1 < 0.35 predicted)	US$10,812	US$6,770	63%

** According to American Thoracic Society staging system.*
§ Costs included initial drug acquisition, add-on drug acquisition, oxygen therapy, laboratory/diagnostic test, clinic visit, emergency department visit and hospitalisation costs.
Data source: Hilleman et al. (2000)

The Confronting COPD survey also showed that poorly-controlled COPD was common (Wouters, 2003). The US had the highest rates of poor symptom control as well as the highest individual patient costs of COPD when compared with Spain, the UK, Canada, France, Italy and the Netherlands. This indicates the importance of disease management as a means to reduce disease burden.

9.3.2 United Kingdom

The Confronting COPD survey estimated that the mean annual direct costs per COPD patient in the UK was £819 (or US$1,254) in 2000/2001 (Britton, 2003; Wouters, 2003). Indirect costs such as productivity loss accounted for another £820 per patient. Furthermore, the direct costs of caring for COPD patients were higher in the more severe cases (Table 9.6) (Britton, 2003). With an estimate of 600,000 COPD patients, the annual direct costs of COPD to the National Health Service were more than £491 million (US$752 million).

Table 9.6 Estimated direct costs per COPD patient, by severity, United Kingdom, 2000/2001

COPD severity*	Annual direct costs per patient
Mild	€ 395 (US$390)
Moderate	€ 926 (US$914)
Severe	€ 3,036 (US$2,997)

** According to Medical Research Council Dyspnoea Scale*
Data source: Britton (2003)

9.3.3 Australia

Hospitalisation for COPD accounted for the largest proportion (37%) of the direct costs incurred in 1993-1994 in Australia (Crockett, Cranston & Moss, 2002). In 1993-1994, direct costs for COPD were estimated to be AU$300 million (US$204 million), whereas costs for hospitalisation accounted for AU$112 million (US$76 million). In 2000-2001, the direct costs increased to about AU$503 million (US$292 million) and hospitalisation costs accounted for AU$188 million (US$109 million). The hospitalisation costs in 2000-2001, which omitted non-inpatient costs, were nearly double of that incurred in 1993-1994 which included non-inpatient costs.

A recent study estimated that direct health care expenditures, which included expenditures on community health, public health programs, pharmaceuticals, outpatient services, allied health services and research, were AU$857.3 million (US$730 million) in 2008, of which 55.2% were for hospitalisation (Access Economics Pty Limited, 2008). On average, the direct health care costs per COPD patient were AU$723.9 (US$616) in 2008, of which AU$399.4 (US$340) was attributed to hospitalisation.

9.4 Summary

Hospitalisation was the major component of direct costs of COPD. In 2006, about HK$985 million were spent on COPD hospitalisation in Hong Kong, the majority (86%) of which was for people aged 65 and above, accounting for HK$844 million. On average, the annual costs of hospital admissions incurred for each COPD patient were approximately HK$56,051, whereas the costs for each older patient were approximately HK$66,287. By 2036, the costs of hospitalisation for COPD patients aged 65 and above would increase to approximately HK$7.8 billion. The costs for managing severe patients could be 3 to 8 times as costly as managing moderate cases. This would imply that preventing patients from moving from a moderate to a severe disease state would be worthwhile in terms of reducing costs and improving patients' quality of life. In addition, smoking accounted for HK$430 million public hospital costs of COPD in the population aged 35 and above in 1998. This finding indicated that smoking cessation could help to reduce the direct costs incurred. International comparisons of costing statistics were not straightforward, partly due to differences in inclusion criteria, calculation methods and purchasing power parity. Nevertheless, as in the US and the UK, the direct costs increased with disease severity.

Chapter 10

Factors Affecting Burden of COPD - Smoking and Air Pollution

Chapter 10

Factors Affecting Burden of COPD – Smoking and Air Pollution

10.1 Introduction

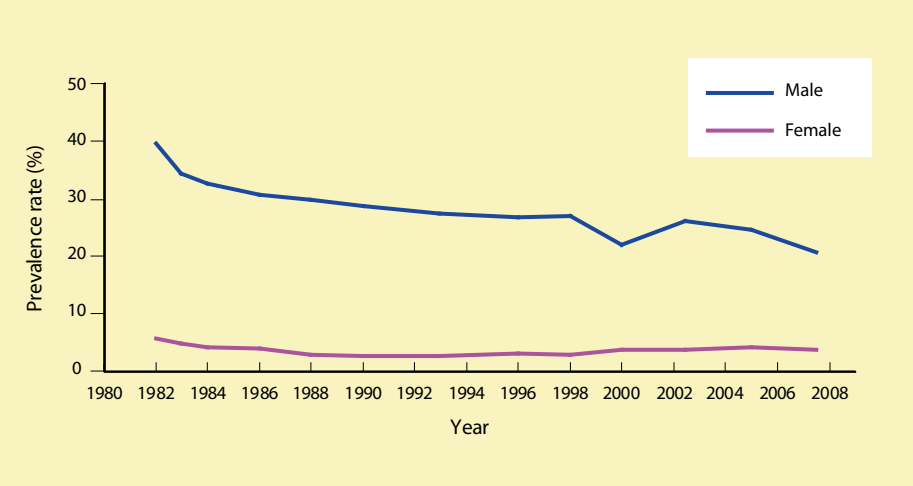
Tobacco smoking is perceived to be the primary cause of COPD. Trends in smoking prevalence could be expected to reflect COPD prevalence trends in different countries and regions, perhaps with a lag period as people generally start to smoke in adolescence and develop COPD in their early 40s. In high-income countries, about 73% of DALY lost to COPD were related to smoking (Lopez *et al*., 2006b). The risk of COPD would be reduced by more than half (56% for men and 63% for women) after a smoker quitted smoking for 5 years (Lin *et al*., 2008). There was also evidence that the relative risk for COPD was lower in populations that started smoking late than those that started early. In this chapter, the prevalence of smoking will be examined.

While smoking is a well-known risk factor for COPD, there are other less well-established risk factors such as second-hand smoke and outdoor air pollution. In high-income countries, it was estimated that about 1% of DALY lost to COPD might be related to urban air pollution (despite of large uncertainty in the estimation) (Lopez *et al*., 2006b). In this chapter, second-hand smoke and outdoor air pollution will also be briefly discussed.

10.2 Smoking prevalence

In Hong Kong, the prevalence of daily cigarette smokers aged 15 and above decreased in general, from 1982 to 2008 (Figure 10.1) (Tobacco Control Office, Department of Health of Hong Kong SAR, 2008). The male smoking prevalence rate decreased substantially from 39.7% in 1982 to 20.5% in 2007/2008, while the female smoking prevalence rate slightly decreased from 5.6% to 3.6% in the same period.

Figure 10.1 Prevalence rates of daily cigarette smokers# (aged 15 and above), by sex, Hong Kong



#: Daily cigarette smokers defined as having a daily cigarette smoking habit at the time of survey.
Data source: Tobacco Control Office, Department of Health of Hong Kong SAR (2008)

Prevalence rate further analysed by age group and sex showed an unfavourable trend. Despite the overall decreasing trend, smoking prevalence rate has been increasing among younger women in Hong Kong. The prevalence rate of daily female smokers aged 20 to 29 increased from 1.5% in 1982 to 6.1% in 2007/2008; that the prevalence rate also increased among those aged 30 to 39 from 2.6% to 6.4% in the same period. This increasing smoking prevalence rate in the younger female population would be likely to contribute to a general increase in COPD prevalence in the future.

10.3 Comparison of smoking prevalence with other countries

The smoking prevalence rate among the older male population in Hong Kong was higher than that in the US, the UK and Australia, but that among the older female population was lower (Chau & Woo, 2008). Details about trends in individual countries are presented in subsequent sections.

10.3.1 United States

The age-adjusted smoking prevalence rate among males aged 18 and above in the US decreased from 51.2% in 1965 to 22.0% in 2007, while that of females in the same age group decreased from 33.7% to 17.5% (Centers for Disease Control and Prevention, US, 2009). Smoking prevalence rate of males started off being higher than that of females in all age groups but, over time, prevalence rate of males decreased while that of females aged 65 and above went up until late 1990s before it dropped (Table 10.1). The gap between males and females became smaller

and, in 1998 and 1999, smoking prevalence rates in females aged 65 and above exceeded their male counterparts. A high smoking prevalence rate during the 1960s to 1980s might contribute to increased mortality and prevalence of COPD in the 1980s to early 1990s.

Table 10.1 Annual prevalence rates of current smokers#, by age group and sex, United States, 1965-2007

	Male			Female		
Year	45-64	65+	18+ (age-adjusted*)	45-64	65+	18+ (age-adjusted*)
1965	51.9%	28.5%	**51.2%**	32.0%	9.6%	**33.7%**
1974	42.6%	24.8%	**42.8%**	33.4%	12.0%	**32.2%**
1979	39.3%	20.9%	**37.0%**	30.7%	13.2%	**30.1%**
1985	33.4%	19.6%	**32.2%**	29.9%	13.5%	**27.9%**
1990	29.3%	14.6%	**28.0%**	24.8%	11.5%	**22.9%**
1995	27.1%	14.9%	**26.5%**	24.0%	11.5%	**22.7%**
2000	26.4%	10.2%	**25.2%**	21.7%	9.3%	**21.1%**
2005	25.2%	8.9%	**23.4%**	18.8%	8.3%	**18.3%**
2007	22.6%	9.3%	**22.0%**	19.5%	7.6%	**17.5%**

 # Current smokers defined as having smoked at least 100 cigarettes and smoked every day or some days at the time of survey
** The age-adjusted rates used the 2000 US standard population as standard.*
Data source: Centers for Disease Control and Prevention, US (2009)

10.3.2 United Kingdom

Overall smoking prevalence rate dropped through 1972 to 2008 in the UK but stabilised towards the end of the period, with faster decline in males than females (Table 10.2) (Office for National Statistics of UK, 2010). The smoking prevalence rate among population aged 16 and above in males was higher at the beginning and gradually declined to the same level as females towards 2008. This may explain the faster increase in prevalence rate of COPD in females in the 90s. In 2008, the smoking prevalence rates for males and females aged 50 to 59 were 23% and 20%, respectively; for males and females aged 60 years and older, the rates were 13% and 12%, respectively.

Table 10.2 Smoking prevalence rates, by age group and sex, United Kingdom, 1972-2008

	Male			Female		
Year	50-59	60+	16+	50-59	60+	16+
1972	54%	47%	**52%**	47%	25%	**41%**
1976	49%	40%	**46%**	46%	24%	**38%**
1982	42%	33%	**38%**	40%	23%	**33%**
1986	35%	29%	**35%**	35%	22%	**31%**
1992	28%	21%	**29%**	29%	19%	**28%**
1996	28%	18%	**29%**	26%	19%	**28%**
2002	27%	17%	**27%**	24%	14%	**25%**
2006	23%	13%	**23%**	22%	12%	**21%**
2008	23%	13%	**22%**	20%	12%	**21%**

Data source: Office for National Statistics of UK (2010)

10.3.3 Australia

In Australia, the prevalence rates of daily smokers aged 60 and above were 10.8% for men and 8.8% for women in 2007 (Australian Institute of Health and Welfare, 2008). The age-adjusted prevalence rate of current smokers decreased in the 1980s, then levelled off during the 1990s, then decreased again in the 2000s (Table 10.3) (Scollo & Winstanley, 2008). The decline was observed in all age groups, with the rate in males declining faster than that in females. Young adults aged 18 to 39 had the highest smoking prevalence rate. Although the rates for both sexes declined over time, it was found that young female adults were more likely to take up smoking (Morley & Hall, 2008). The relatively lower smoking prevalence rate among the older population might be partly explained by the higher mortality rates related to smoking (Scollo & Winstanley, 2008).

Table 10.3 Prevalence rates of current smokers#, by age group and sex, Australia, 1980-2007*

	Male			Female		
Year	40-59	60+	18+	40-59	60+	18+
1980	44%	23%	**40%**	27%	16%	**29%**
1983	41%	31%	**40%**	30%	16%	**29%**
1986	35%	24%	**34%**	27%	18%	**28%**
1989	28%	21%	**30%**	25%	16%	**27%**
1992	31%	16%	**29%**	23%	12%	**24%**
1995	29%	16%	**29%**	21%	11%	**23%**
2098	27%	14%	**27%**	26%	11%	**25%**
2001	25%	11%	**25%**	21%	9%	**21%**
2004	24%	13%	**24%**	22%	9%	**21%**
2007	23%	12%	**21%**	19%	10%	**18%**

 # Include persons who smoked any combination of cigarettes, pipes or cigars.
** All data except those in 2007 weighted to the 2001 census population data.*
Data source: Scollo & Winstanley (2008)

10.3.4 China

In China, prevalence rates of current smokers between 1984 and 1996 increased among people aged below 30 and those aged 35 to 44, but decreased among people aged 45 and above (Yang *et al*., 1999). From 1996 to 2002, the smoking prevalence decreased in all age groups, except for males aged 15 to 19 and females aged 15 to 24 (Yang *et al*., 2005). In 2002, the prevalence rates of current smokers among population aged 15 and above were 57.4% for men and 2.6% for women (Table 10.4).

Table 10.4 Prevalence rates of current smokers# (aged 15 and above), by sex, China, 1996 and 2002

Year	Male	Female	Both sexes
1996	63.0%	3.8%	35.3%
2002	57.4%	2.6%	31.4%

 # Current smokers defined as those having smoked tobacco products 30 days prior to the survey.
Data source: Yang et al. (2005)

Another study conducted in 2000-2001 showed that the prevalence rate of current smokers was higher in younger men than older men, but lower in younger women than older women (Gu *et al*., 2004). In 2000-2001, the prevalence rates of current smokers among those aged 65 to 74 were 48.9% for men and 11.2% for women.

10.3.5 Singapore

The prevalence rate of daily smokers among males aged 18 to 69 in Singapore decreased from 33.2% in 1992 to 23.7% in 2007, but that of females in the same age group increased slightly from 3.1% to 3.7% over the same period (Table 10.5) (Ministry of Health of Singapore, 2005 and 2009). While a notable decrease in prevalence rate was observed for women aged 45 to 69, a notable increase was observed for women aged 25 to 44. In 2007, the prevalence rates of daily smokers among people aged 60 to 69 were 20.4% for men and 2.1% for women.

Table 10.5 Prevalence rates of daily smokers#, by age group and sex, Singapore, 1992-2007

Age group	1992		1998		2001		2004		2007	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
25-44	35.2%	2.4%	27.2%	2.6%	25.0%	3.8%	24.3%	4.2%	23.8%	4.8%
45-69	31.5%*	4.7%*	27.6%	3.1%	23.3%	1.6%	21.7%	1.9%	23.8%	1.2%
Whole population (18-69)	33.2%	3.1%	27.1%	3.2%	24.3%	3.6%	21.8%	3.5%	23.7%	3.7%

 # Daily smokers defined as those having smoked cigarette at least once a day.
** Refer to the age group 45-64 years.*
Data sources: Ministry of Health of Singapore (2005 and 2009)

10.3.6 Japan

The prevalence rate of current smokers among males aged 20 and above in Japan decreased from 59.7% in 1986 to 36.8% in 2008, but that of females in the same age group increased slightly from 8.6% in 1986 to 12.0% in 2004 and decreased to 9.1% in 2008 (Table 10.6) (Ministry of Health, Labour and Welfare of Japan, 2009). This increase in women was mainly seen in those aged 20 to 59, and the smoking prevalence rate of this group levelled off since the late 90s. In 2008, the prevalence rates of current smokers among people aged 70 and above were 19.1% for men and 3.2% for women.

Table 10.6 Prevalence rates of current smokers#, by age group and sex, Japan, 1986-2008

Year	Male				Female			
	50-59	60-69	70+	20+	50-59	60-69	70+	20+
1986	57.4%	55.4%	41.8%	**59.7%**	7.6%	7.5%	7.4%	**8.6%**
1989	53.3%	50.4%	34.5%	**55.3%**	9.1%	6.8%	8.2%	**9.4%**
1992	47.2%	48.1%	38.4%	**50.1%**	6.6%	6.9%	7.0%	**9.0%**
1995	54.2%	47.0%	31.1%	**52.7%**	9.1%	7.6%	6.3%	**10.6%**
1998	52.5%	41.8%	32.4%	**50.8%**	9.6%	7.9%	5.4%	**10.9%**
2001	49.6%	35.9%	29.0%	**45.9%**	9.7%	6.5%	3.4%	**9.9%**
2004	47.7%	33.3%	24.0%	**43.3%**	13.7%	7.6%	4.5%	**12.0%**
2008	41.2%	32.6%	19.1%	**36.8%**	9.5%	4.9%	3.2%	**9.1%**

 # Current smokers defined as those having smoked more than 100 cigarettes or for more than 6 months, and smoked everyday or some days during the past one month.
Data source: Ministry of Health, Labour and Welfare of Japan (2009)

10.4 Second-hand smoke

The 2006 US Surgeon General's Report concluded that the evidence is suggestive but not sufficient to infer a causal relationship between second-hand smoke exposure, the risk of COPD and also of chronic respiratory symptoms (Department of Health and Human Services of US, 2006). However, there is sufficient evidence to support a causal relationship between second-hand smoke with asthma induction and exacerbation, as well as with eye and nasal irritation (Benninger, 1999; Thomson, 2007).

In China, the prevalence rates of passive smoking in non-smokers were 53% in 1996 and 52% in 2002, with higher prevalence rates among the middle-aged (Yang *et al*., 2005). It was estimated that passive smoking accounted for 143,000 deaths from COPD in 2003 (compared with 525,000 from direct smoking) (Lin *et al*., 2008). It therefore makes sense to avoid exposure to second-hand smoke as far as possible.

10.5 Outdoor air pollution

While outdoor air pollution has been declining in most developed countries in recent decades, it is still increasing in the developing world and Asia. Air pollution levels are usually cited with regard to the four criteria air pollutants, namely particulates, nitrogen dioxide, sulphur dioxide and ozone. A study of UK postmen in the 1950s (Fairbairn & Reid, 1958) found an increased prevalence of COPD in those postmen who worked in more polluted areas. A later study (Holland & Reid, 1965) reported reduced lung function in postmen working in more polluted cities compared to those working in less polluted areas. These findings were independent of smoking status and have been confirmed in many other studies. The role of outdoor air pollution in the development of COPD is not yet supported by evidence and more research is needed. However, there is strong evidence to support an association between outdoor air pollution and worsening of existing COPD as well as increased exacerbations (Holgate *et al*., 1999). This health damage results in air pollution-associated costs which are difficult to measure precisely. One study in Los Angeles, US, in 1989, estimated the direct costs of health care and lost productivity due to ozone and particulate matter to be over US$10 billion per year but other reported estimates were higher (Hall *et al*., 1992).

Air pollution is increasing in developing countries, including China, because of the increased use of fossil fuels for energy production and transport. Hong Kong also suffers from air pollution due to increased levels of local traffic as well as lax regulations governing the output of pollutants by power stations and vehicle exhausts. To some extent, Hong Kong also shares the same air as the Pearl River Delta which is a fast developing economic zone in China (Loh *et al*., 2008). As a result, we have observed rapid increase in air pollutant levels in Hong Kong in recent years and the criteria

pollutants are all higher, in some cases very much higher, than the WHO's recommended target levels for health protection (Environmental Protection Department of Hong Kong SAR, 2009; Hedley *et al*., 2008). There is no evidence that air pollution levels in Hong Kong are going to fall in the near future.

The question of whether outdoor air pollution in Hong Kong leads to new cases of COPD is currently unanswered, but it is certain to lead to worsened existing cases, increased costs in managing quality and length of life of patients, as well as demands in medical resources. A significant association was identified between high levels of air pollution and increased admissions for chronic respiratory disease in a local study (Ko *et al*., 2007). The direct health care costs and lost productivity due to air pollution effects in Hong Kong have been estimated to be over HK$1.9 billion per year (approximately US$240 million) (Hedley *et al*., 2008). Many health effects are likely to impact on cardiorespiratory systems. It is difficult to separate out the costs of respiratory disease from the cardiac effects, but estimates have shown that more than half of the health care costs are due to respiratory problems.

10.6 Summary

In Hong Kong, despite an overall decrease in the prevalence rate of current daily adult smokers, the smoking prevalence rate in younger female population has increased over the years. This trend may result in an increase in COPD prevalence and mortality among older women in later years. The increase in smoking prevalence rate in the younger female population has also been observed in China, Japan and Singapore.

While smoking is a well-known risk factor for COPD, there are other less well-established risk factors such as second-hand smoke and outdoor air pollution. It is worth noting that a significant association was identified between high levels of air pollution in Hong Kong and increased hospital admissions of chronic respiratory disease. Further studies are needed to fully examine the risk of COPD associated with second-hand smoke and air pollution.

Chapter 11

Conclusions and Implications for Health and Social Services

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COPD mortality in Hong Kong follows the same steadily declining trend as reported in other developed countries over the past twenty years. There is a lack of data regarding the trends of incidence, although there is no marked change in incidence rates. A reduction in mortality may be the result of a reduction in incidence triggered by smoking prevention and cessation efforts, improved socioeconomic circumstances and living environment, and enhanced disease management.

The gender gap in mortality may decrease over time, since there is a rise in smoking prevalence among young women. Assuming a time-lag period of 20-30 years after beginning the smoking habit, together with a higher life expectancy in women, it is possible that the prevalence of COPD among women may increase.

Since there is an increasing prevalence rate with age, the number of older people with COPD is expected to rise. The number of people with COPD among the very old (≥85 years old) will also increase at a faster rate. The substantial direct and indirect costs associated with COPD indicate that preventive efforts should receive high priority in health policies.

While preventive efforts should continue to concentrate on reducing uptake of smoking and smoking cessation, the impact of air pollution in COPD should not be neglected. A correlation in air pollution indices and hospital admissions for respiratory diseases has been identified (Ko et al., 2007) and the health service impact quantified (Hedley Environmental Index, 2010). Lack of data precludes estimations on the contribution of air pollution on the future burden of COPD.

Efforts to identify factors that may prevent the progression from mild to severe COPD are important, as the economic burden for severe disease is far greater than that for mild disease. Treatment of severe COPD includes long-term oxygen therapy at home or in residential care home, expensive drugs to prevent exacerbations, broad-spectrum antibiotics to treat infective episodes, and non-invasive ventilation to prolong life. In a setting of progressive deterioration and physical distress, patients' views on treatment options should be taken into account, with maximising their quality of life as the primary goal, particularly in the presence of multiple morbidities. Previous records have shown that patients have requested euthanasia or attempted suicide (with some completed cases). Appropriate end-of-life care should be provided for such patients.

Primary care for COPD patients should be better structured, taking into account the functional dependencies and psychological morbidities, in addition to pharmacological aspects. Patients are commonly re-admitted to hospital in the absence of well-developed community support. While progression of disease may be an unavoidable cause, group-community rehabilitation may provide psychological support as well as maximising physical function. Current community centres may take on this role by providing frequent and continuing support in the form of group activities. Home visits to follow up on the appropriate use of oxygen and the need for adequate equipment may also help those who are confined to home. Residential care homes for the elderly are potential providers of such programmes. The planning and financing of such services would require an integrated approach from health and social services.

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