Title	Explaining coronary heart disease trends in Hong Kong: creation of a model for policy and planning.
Author(s)	McGhee, SM; So, JC; Thomas, GN
Citation	Hong Kong Medical Journal, 2009, v. 15 Suppl 2, p. 22-25
Issued Date	2009
URL	http://hdl.handle.net/10722/60294
Rights	Hong Kong Medical Journal. Copyright © Hong Kong Academy of Medicine Press.

SM McGhee 麥潔儀
JC So 蘇 正
GN Thomas

Explaining coronary heart disease trends in Hong Kong: creation of a model for policy and planning

Key Messages

1. The largest contribution of coronary heart disease (CHD) mortality reductions was from medical treatment.
2. A smaller contribution was estimated to be due to risk factors changes.
3. Improvement of treatment uptake levels can have a substantial effect in reducing CHD mortality.

Introduction

Coronary heart disease (CHD) is the most common cause of death in developed countries. The death rate due to CHD is increasing in most developing countries and is projected to become the leading cause of death in 2020 with over 7 million deaths each year. In Hong Kong, heart disease was the second highest cause of mortality in 2005 (after cancer) and accounted for about 10% of all deaths. In 2005, the crude death rate due to CHD in Hong Kong was approximately 60 per 100 000 inhabitants. Although this CHD mortality rate is lower than that in many western countries, it is still useful to examine the impact of therapies versus changes in risk factors on CHD mortality rates, in order to predict future trends.

Many large cohort studies have already identified trends in CHD, including the World Health Organization MONICA project and the Framingham study. However, in a number of countries including China, a further modelling approach using easily available data has been used to explain trends in terms of treatment or risk factor changes.[1] We sought to apply this model to Hong Kong.

Aim

The aim of the impact model project was to relate recent CHD trends to treatments and changes in population risk factors.

Methods

This study was conducted from October 2005 to September 2006. A Microsoft Excel cell-based model was used to examine CHD mortality in Hong Kong between 1989 and 2001, as the best quality data were collected in these years. The impact model was originally created for the UK[2] and has since been applied to many other countries. The main model used in Hong Kong was that developed for the US in 2005[3] but with modifications. The model was applied to males and females aged 25 to 84 years only. The age-group of 85 years and older was not included because of limited data.

Medical and surgical treatments

Population and mortality data were obtained from the Hong Kong Census and Statistics Department and the Department of Health respectively. Numbers of discharges and deaths were obtained from the Hospital Authority clinical data. Treatment prescription rates and case fatality data were based initially on the UK model. Data on the relative risk of each treatment were obtained from published controlled trials and meta-analyses that were also used in previous impact models. The prevalence of hypertension, community angina and heart failure cases were based on local publications. Overall patient compliance and adjustments for potential overlap between CHD patient groups were based on the same assumptions as in previous impact models.

Risk factors

Changes in major risk factors may also have contributed to changes in mortality rates for CHD. The classical risk factors included in this model were blood pressure, cholesterol, body mass index, smoking and diabetes. Other factors

Hong Kong Med J 2009;15(Suppl 2):S22-5

Department of Community Medicine, The University of Hong Kong
SM McGhee, JC So, GN Thomas

HHSRF project number: 03040851

Principal applicant and corresponding author:
Dr Sarah M McGhee
Department of Community Medicine, The University of Hong Kong, 5/F, William MW Mong Block, Li Ka Shing Faculty of Medicine, Pokfulam, Hong Kong SAR, China
Tel: (852) 2819 9193
Fax: (852) 2855 9528
E-mail: smmcghee@hkucc.hku.hk

Table 1. Deaths prevented or postponed by treatments in Hong Kong 1989-2001

Treatments	Deaths prevented or postponed	Minimum estimate	Maximum estimate
Acute myocardial infarction (AMI)	320	191	522
Treatments in effect 1989	-125	-40	-244
Total secondary prevention			
Secondary prevention after AMI	247	145	496
Treatments in effect 1989	-25	-8	-54
Secondary prevention after angioplasty	44	17	77
Chronic angina			
Unstable angina	10	7	18
Community angina	44	20	92
Heart failure			
Hospital heart failure	164	87	325
Community heart failure	0	-5	13
Hypertension and hyperlipidaemia treatment			
Hypertension	298	131	616
Treatments in effect in 1989	-155	-40	-401
Hyperlipidaemia	106	45	219
Total treatments			
2001	1233	637	2378
1989	-305	-88	-699
Treatments between 1989 and 2001	928	550	1678

such as physical inactivity were not included in this model since there were no reliable data. Data on risk factor prevalence were obtained from three local studies: China Light and Power study in 1990, Cardiovascular Risk Factor Prevalence (CRFP) study in 1995-96 and Population Health Survey (PHS) in 2003/2004.

Mant and Hicks correction

Multiple medications could be taken by individual CHD patients. However, the mortality reduction due to polypharmacy is unlikely to be simply the additive effect of each separate treatment. The cumulative effect was estimated by using the Mant and Hicks approach and separate relative risk reductions (RRRs) where: benefit = 1 - [(1 – RRR from treatment A) * (1 – RRR from treatment B) * … etc].

Sensitivity analysis

Sensitivity analysis was performed for each main assumption and estimate included in the model, such as uptake level, case fatality, and relative risk. Assumptions about maximum and minimum values were based on the highest or lowest values that could be obtained from internationally published studies. Otherwise, +/- 20% of the main parameters were used to generate the maximum or minimum possible for deaths prevented or postponed (DPP) for each treatment or risk factor.

Model validation

The number of DPP was estimated for each medication and cardiovascular risk in between 1989 and 2001, stratified by gender and age. This number was compared with the actual change in CHD mortality in the period, where the actual change was calculated as the number of deaths attributed to CHD in 2001 if the mortality rate stayed at the 1989 level minus the number of observed CHD deaths in 2001.

Results

Between 1989 and 2001, the actual mortality rates for CHD in Hong Kong in persons aged 25 to 84 years decreased from 79 to 76 per 100 000 in men and from 60 to 42 per 100 000 in women. The mortality rates were based on 3-year averages for the years 1988-90 and 2001-03 respectively. Using the population data and mortality rate in Hong Kong for 1989 and 2001, we estimate that there would have been 3928 CHD deaths expected in 2001 if the 1989 mortality rates had persisted, but only 2742 deaths were observed in 2001. Therefore 1186 CHD deaths (the actual fall) were prevented or postponed between 1989 and 2001.

Medical and surgical treatments

The model estimated that 1233 CHD deaths were prevented or postponed by medical and surgical treatments in 2001. After applying the Mant and Hicks correction and adjusting for treatments that were already used in 1989, there were 928 deaths estimated to be prevented or postponed by treatment between 1989 and 2001 (Table 1). Treatments for initial acute myocardial infarction (AMI), secondary prevention post AMI, as well as heart failure, hypertension and hyperlipidaemia treatments have contributed to a larger proportion of the mortality reductions; respectively estimated as 195, 221, 164 and 249 CHD deaths. Smaller contributions to DPP were estimated from secondary prevention post angioplasty (44 deaths) and treatment for chronic angina (54 deaths).

Risk factors

The changes in cardiovascular risk factors did not contribute a great deal to CHD DPP in Hong Kong between 1989 and 2001. Only 336 CHD deaths were prevented or postponed by changes in all major risk factors (Table 2). The largest contribution came from the decline in smoking prevalence, which prevented 328 CHD deaths. The decrease in mean

Table 2. Deaths prevented or postponed by risk factors in Hong Kong 1989-2001

Risk factors	Deaths prevented or postponed	Minimum estimate	Maximum estimate
Blood pressure	156	133	182
Hypertension treatments	-143	-	-
Risk factors minus treatment	13	0	156
Smoking	328	206	563
Cholesterol level	281	239	401
Cholesterol treatments	-177		
Cholesterol diet only	104	0	281
Obesity	47	34	61
Diabetes	-156	-115	-195
Risk factor total	336	125	866

diastolic blood pressure in men avoided 213 CHD deaths, while 57 more deaths were produced due to the increase in blood pressure in women. As 143 deaths were prevented by hypertension treatments, the total CHD deaths prevented by population blood pressure changes therefore decreases to 13 after adjustment. The decline in mean cholesterol levels resulted in 281 CHD DPP. However, 177 of these deaths were prevented by cholesterol treatments and only 104 by the change in cholesterol level. Decreased mean body mass index could have prevented 47 CHD deaths, 10 in men and 37 in women. Diabetes prevalence was the only risk factor that resulted in an overall increase in deaths. Increased diabetes prevalence resulted in 156 more CHD deaths.

Validation

The model estimated that a total of 1264 deaths were prevented or postponed between 1989 and 2001 compared to 1186 fewer deaths in reality. Of these, 78% of the actual reduction was attributable to treatment and 28% to risk factor changes. The model overestimated the deaths prevented or postponed and the overall model fit with actual changes in mortality is 106%—143% for men and 68% for women.

Sensitivity analyses

Sensitivity analyses showed that CHD deaths prevented or postponed were consistent among all medical treatments. The effects of all treatments together prevented 928 deaths, with a minimum of 550 and maximum 1678. All risk factor changes together prevented 336 deaths, with a minimum of 125 and maximum 866. By all risk factors changes, DPP showed a greater contribution for the maximum estimation when compared to the best estimation, which showed that DPP by risk factors may be underestimated in the model.

Discussion

As the most westernised city in China, Hong Kong has experienced a rise in CHD mortality one to two decades earlier than the remainder of China. The mortality rate for CHD in Hong Kong was still increasing in the 1970s and peaked around 1980. Although the crude death rate has remained fairly stable, age-standardised mortality has dropped substantially over the past two decades. However, the trends in mortality reduction were not similar to those in western countries. Mortality due to CHD in Hong Kong has remained low despite rapid economic growth. The mortality rate is about half of that observed in the US and UK. The influences of changes in treatments and risk factors on CHD mortality could therefore show a different effect.

Medical and surgical treatments

The advances in treatments have no doubt made a great contribution to preventing CHD mortality over the last 20 years. Some of the therapies such as statins and aspirin are very cost-effective in primary and secondary care. New surgical treatments such as angioplasty also became available over this period. Although the effect of medical treatments may be overestimated in the model, a large proportion of DPP was estimated to result from advances in treatment. However treatment uptake rates may have been relatively low for some therapies, possibly due to the cost of implementation, patients dying before arriving at hospital or the treatment not being offered. A UK study showed that improvements in uptake could make a large impact on the reduction of CHD mortality, which suggested that DPP by current treatments would be double if the uptake levels increase to 80%.[4] Thus, the effects of medical treatments in Hong Kong could be maximised if the future policies aim to improve treatment uptake of medications.

Risk factors

Only 28% of DPP was attributed to risk factor changes. The decline in smoking prevalence was attributed with the largest proportion of CHD mortality reduction among all the risk factors. A recent study proposed that the epidemic of tobacco in Hong Kong has entered an advanced period,[5] with cigarette consumption reaching a peak around 1970, 20 years later than the US, and started to decline as also observed in US. The smoking trend in Hong Kong was thus predicted to be repeating the US trend but with a two decade delay.

Mean diastolic blood pressures in Hong Kong have remained fairly stable between 1989 and 2001. However, mean systolic blood pressure was observed to increase in the same period, which is possibly due to ageing of the Hong Kong populations. Thus using diastolic blood pressure alone for calculating DPP may overestimate the real changes on mortality reduction by blood pressure.

The dietary and fat intake pattern in the local Chinese population appeared to be close to the recommended level for cardiovascular health,[6] suggesting unhealthy dietary patterns relating to fat consumption may not be a major determinant of CHD deaths. It is therefore unlikely that a large proportion of deaths from CHD could be prevented by a change of diet, at least when mediated through fat consumption. The estimated DPP associated with changes in mean cholesterol levels found over this period could be the effect of treatment. Therefore, it was assumed that the DPP due to change in cholesterol levels was mainly contributed by treatments and not lifestyle change.

Mean body mass index (BMI) for Hong Kong women has declined substantially since 1989, while the BMI for men was similar in 1989 and 2003. The decline in female BMI may be due to social pressure for a lower ideal weight for women or a consequence of including a higher proportion of middle-aged women who are employed in the data from the CRFP and PHS study, where employed middle-aged women tended to have a lower BMI than those staying at home.

Diabetes prevalence was the only risk factor that was observed to clearly increase over the study period. In the model, 156 CHD DPP were attributed to this change. The increase in diabetes among the Hong Kong population may be due to changes in lifestyle such as a decrease in physical activity.

In comparison with other countries, the low mortality rate from CHD in Hong Kong seems to be consistent with most Asian countries, except Singapore (despite having a similar level of economic development). Singapore is the only country in Asia in which the CHD mortality rate has reached the level of western countries. The difference in serum cholesterol concentrations would explain the difference in CHD mortality and could be related to the high fat intake. The Beijing model also attributed the large increase in CHD deaths in mainland China to a rise in cholesterol levels. Change in diet and other lifestyle factors from traditional Chinese to mixed modern Chinese and western patterns seems to be the main issue in changes in CHD mortality rates. It is possible that Hong Kong may experience these changes in the future if western diets continue to be popular among the younger age-groups, as indicated by the prevalence of obesity in Hong Kong children and current dietary practices.

Limitations

The impact model is highly dependent on the quality of data available. Few comprehensive studies could be found for CHD treatments and risk factors in Hong Kong, data had to be estimated using the UK and Beijing models and assumptions made in those models. Adjustments were made when possible to tailor the data for Hong Kong. Risk factor trend data were very limited in Hong Kong. The smoking trend was the only risk factor with very reliable data. For the other risk factors, only three large cohort studies were considered good enough to use in the model. This limitation of the data sources impeded delineation of trends in risk factors. Sensitivity analysis showed that the mortality reduction attributed to risk factor changes may contribute a larger proportion, as the model may have underestimated the risk factor changes in Hong Kong between 1989 and 2001 or possibly overestimated the DPP statistics due to medical treatment.

The results appear to predict more than the actual number of deaths reduced. However, the overall pattern is similar to the Beijing model, with larger contributions to mortality reductions by all medical treatments and a relatively small contribution from risk factor changes. Unlike the Beijing model, the Hong Kong model did not find an increase in deaths from risk factor changes. The Hong Kong model results fall between those for China and the US. Mortality due to CHD in Hong Kong is falling like that in the US, but locally the decline starts from a much lower peak mortality level.

Conclusions

Up to 78% of CHD mortality reduction between 1989 and 2001 was attributed to improvements in treatment while 28% was attributed to changes in population risk factors. The findings in Hong Kong were quite different to European studies, but similar to those observed in China. The CHD mortality rate in Hong Kong was already very low compared to western countries with similar levels of economic development. The model is consistent with improvements in treatment uptake and control of risk factors resulting in further CHD mortality reductions.

Acknowledgement

This study was supported by the Health and Health Services Research Fund (HHSRF: 03040851), Food and Health Bureau, Hong Kong SAR Government.

References

1. Critchley J, Liu J, Zhao D, Wei W, Capewell S. Explaining the increase in coronary heart disease mortality in Beijing between 1984 and 1999. Circulation 2004;110:1236-44.
2. Capewell S, Morrison CE, McMurray JJ. Contribution of modern cardiovascular treatment and risk factor changes to the decline in coronary heart disease mortality in Scotland between 1975 and 1994. Heart 1999;81:380-6.
3. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. N Engl J Med 2007;356:2388-98.
4. Capewell S, Pell JP, Morrison C, McMurray J. Increasing the impact of cardiological treatments. How best to reduce deaths. Eur Heart J 1999;20:1386-92.
5. Lam TH, Ho SY, Hedley AJ, Mak KH, Peto R. Mortality and smoking in Hong Kong: casecontrol study of all adult deaths in 1998. BMJ 2001;323:361.
6. Woo J, Leung SS, Ho SC, Sham A, Lam TH, Janus ED. Dietary practices and lipid intake in relation to plasma lipid profile in Hong Kong Chinese. Eur J Clin Nutr 1997;51:467-71.