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Disease burden of breast cancer in Hong Kong: an exploration of trends for screening policy and resource allocation

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KEY MESSAGES

1. The increased risk in breast cancer incidence has continued, likely owing to ageing and cohort effects. Nonetheless, breast cancer mortality has remained stable during the past three decades despite some increased projections in older women.
2. Future research to investigate the underlying reasons for the increased projections for older women is warranted.
3. Strong birth cohort trends in breast cancer incidence and mortality are observed.
4. Some birth cohorts have a higher risk of developing breast cancer but a lower chance of dying from it. This can be explained by early detection and the availability of better treatment.
5. The lower risk for women in the 1910s birth cohorts may reflect possible dietary restriction at early ages in the 1910s and the 1920s.

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Introduction

Breast cancer is the most common malignancy and the leading cause of cancer-related death in women, accounting for 10% of new malignancies worldwide annually, and ~22% of all female malignancies.[1] In Hong Kong, breast cancer is the most common cancer and the third leading cause of cancer-related mortality among women, with an age-standardised incidence and mortality of 61.0 and 9.1 per 100 000 in 2011, respectively.[2] The incidence in Hong Kong is rising and exceeding all other East Asian populations except Singapore.[1] Nonetheless, the death rate in Hong Kong has been stable over the past three decades.[2]

Age-period-cohort (APC) models have been used to examine trends in the incidence and mortality over time as well as different biological and environmental causes of cancer.[3] Hong Kong has a history of rapid economic transitions over the past 60 years. Within two to three generations, Hong Kong has transformed from a third-world economy to a major financial centre. Socio-economic development is often followed by improved living standard and clinical interventions that are expected to affect the incidence and mortality of breast cancer. The economic and socio-cultural context of Hong Kong serves as a natural testing ground to examine how contextual history is related to the disease burden associated with breast cancer in a Chinese population.

During the 1990s, progress in early detection and treatment of breast cancer resulted in a decreasing mortality in Caucasian populations. Disparities in the disease incidence and mortality by age group were also observed. It is not known whether the same is found in non-Caucasian populations, such as the Chinese population in Hong Kong. This can be determined by investigation of the trend and projection for breast cancer mortality in Hong Kong.

This study aimed to (1) examine the incidence trend using recently available population data and the APC model; (2) estimate the relative effects of age at diagnosis, period of diagnosis, and birth cohort on trends in breast cancer incidence and mortality using the APC model with reference to the life course theory; and (3) forecast the future trends for the short- to medium-term based on the extrapolation of trends in earlier periods.

Methods

This study was conducted from October 2012 to September 2013 and has been published elsewhere.[4] According to the International Classification of Diseases (ICD) codes of ICD-8 174, ICD-9 174, ICD-10 C50, and C50.0-C50.9, age-specific breast cancer incidence, mortality, and mid-year population figures from 1976 to 2010 were retrieved from the Hong Kong Cancer Registry, Hong Kong Death Registry, and the Census and Statistics Department, respectively. New cases and all deaths associated with breast cancer during the period were included.

Given that breast cancer incidence/mortality was not common for very young age groups, fourteen 5-year age groups from 20-24 to ≥85 years, and seven 5-year periods from 1976-1980 to 2006-2010 were classified.

The age-adjusted incidence and mortality trends (per 100 000 women) in Hong Kong were calculated by a direct-standardisation method, according to the World Standard Population in 2000. By using Joinpoint regression analysis, the trends of breast cancer incidence and mortality from 1976 to 2010 were characterised using segmented annual percentage changes and the overall percentage change (OPC).

APC regression analysis and fitted Poisson regression models on the chronological age, calendar period, and birth cohort effects were conducted. Bayesian inference was applied to estimate the model parameters, and the fitted model was used to project future incidence/mortality in three 5-year periods up to 2025. The parameter estimates and the derived rates were summarised in terms of posterior means and 95% credible intervals. The model goodness-of-fit was measured by the posterior mean deviance D. The resulting models were used to project age-standardised breast cancer incidence and mortality in the short to medium term (until 2021-25). The uncertainty associated with our projections was quantified using 95% projection intervals. All analyses were implemented using Joinpoint 4.0.1, R version 2.10.1 and WinBUGS version 1.4.

Results

Temporal patterns in age-standardised incidence and mortality during 1976-2010 and projections for 2011-2025

The changes in breast cancer incidence or mortality were quantified in terms of segmented annual percentage changes and OPCs (Fig 1). The fourth period centred at 1993 was marked by a joinpoint at which the slope changed significantly for both the incidence and mortality trends. The incidence increased significantly by 1.24% per year until the 5-year period centred at 1993, and then increased further by 2.14% per year. In contrast, mortality increased by 0.35% per year until 1993, and then decreased significantly by 0.39% per year after 1993.

The age-standardised annual incidence rose by a mean of 1.69% per year in the three decades between 1976 and 2010 ($OPC_{incidence,1976-2010}$=1.69). The age-standardised breast cancer incidence was predicted to increase from 56.7 in 2011-15 to 62.5 in 2021-25 per 100 000 women. In contrast, age-standardised annual mortality decreased by a mean of 0.03% per year between 1976 and 2010 ($OPC_{mortality,1976-2010}$=0.03). The rate was projected to decline from 9.3 in 2011-2015 to 8.6 in 2021-2025 per 100 000 women.

Age-period-cohort analyses of breast cancer incidence and mortality trends

The estimated parameter values of the age, period, and cohort components are shown in Fig 2. Due to the identifiability problem of the APC models, where the effects of the three components are linearly dependent, only second-order changes (ie changes in slopes or inflection points) were interpretable. Three inflection points for mortality and incidence trends were readily identified, while there were negligible second-order changes in period effects. In other words, cohort effects were significant in both incidence and mortality trends from 1976 to 2010, but period effects were not significant. With respect to the inflection points for the two birth cohort curves, the first two inflection points (1910 and 1930) coincided and the third inflection points for mortality and incidence birth cohort curves were different (1950 and 1960, respectively).

Deviance information criteria for different combinations of age, period, and cohort effects were also estimated (data not shown). The full APC model provided the best fit with substantially smaller values of deviance information criteria compared with the other partial models.

Trends in incidence and mortality by age group

Incidence trend was projected to increase into the near future for women older than 55 years. Mortality

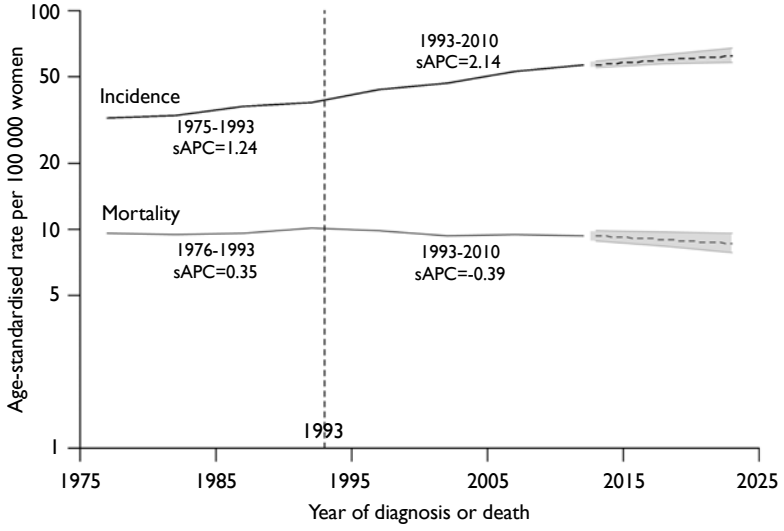

FIG 1. Annual age-standardised female breast cancer incidence and mortality in Hong Kong from 1976 to 2010 and projected incidence and mortality (dotted lines) to 2025 with 95% credible intervals (grey area). The segmented annual percentage change (sAPC) was significantly different from zero (P<0.05), from which the period centred at 1993 (vertical dotted line) was marked by a joinpoint at which the slope changed significantly in both the incidence and mortality trends.

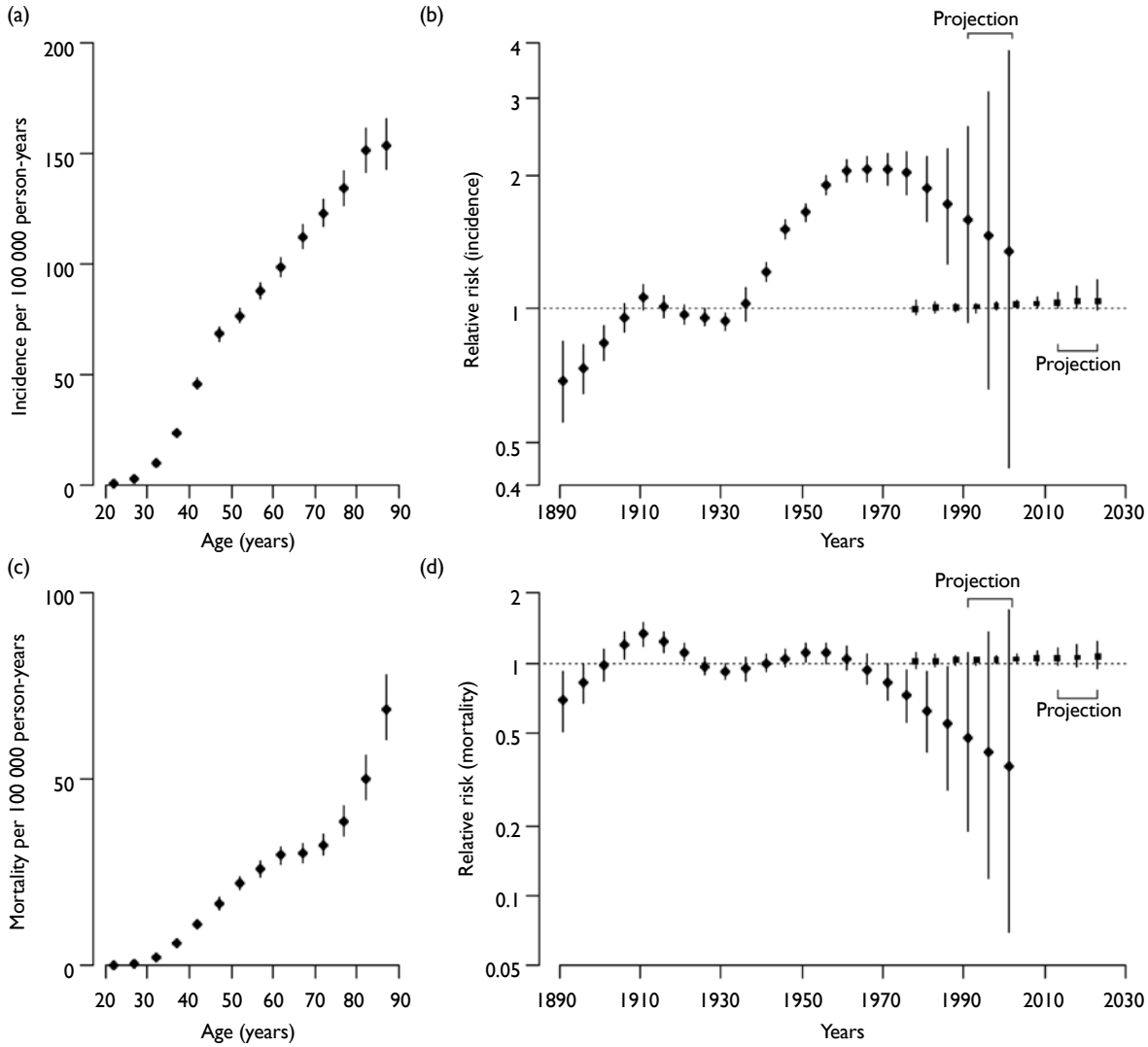

FIG 2. Parameter estimates of age, period, and cohort effects from two age-period-cohort models for female incidence and mortality trends related to breast cancer (deviance information criteria being 916.60 for incidence model and 737.44 for mortality model). Estimated age-specific annual female (a) incidence and (c) mortality related to breast cancer in 5-year age groups in Hong Kong with 95% credible intervals. Estimated relative risks for 10-year birth cohort (beginning from 1889) and 5-year period effects (beginning from 1976) associated with (b) incidence cases and (d) deaths with 95% credible intervals, including projected cohort effects for birth cohorts centred on the years 1993, 1998, and 2003 and projected period effects for periods centred on the years 2013, 2018, and 2023.

trend was projected to decline in the near future for women aged <65 years but increase for those aged ≥65 years.

Discussion

Our findings predict that breast cancer incidence will continue to increase at 0.65% per year, whereas mortality will decrease at 0.56% per year between 2010 and 2025. Cumulatively, this represents a projected increase of 10.2% in incidence and a decrease of 7.5% in mortality. The incidence trends seem to have been driven mainly by ageing and birth cohort effects (ie the intergenerational effects were mainly driven by the post baby boomers), and there are no clear non-linear changes in trend by time-period effect. In contrast, the mortality trend has been relatively stable compared with the increasing incidence trend over the past three decades. The temporal trends in mortality might be explained by an improvement in survival due to better treatment for breast cancer and better responses to newly developed therapy such as paclitaxel use in the 1990s, and adjuvant hormonal and targeted immunotherapy in the 2000s.

Strong birth cohort trends were observed in breast cancer incidence and mortality, with inflection points around birth cohorts at 1910, 1930,

and 1960, and at 1910, 1930, and 1950, respectively. These effects could have been brought about by key historical events that altered the breast cancer risk factors at a population level.

Among the earliest birth cohorts, there was a deceleration in disease risk in incidence and mortality, especially in the 1910s birth cohorts. This trend coincided with the collapse of the Qing dynasty and a subsequent fall in living standards. The lower risk for these women might reflect possible dietary restriction at early ages in the first two decades after the revolution in 1911. Moreover, the increase in disease risk and mortality for the birth cohorts during the 1930s period coincided with the first cohort of women who migrated from China to Hong Kong. The mortality trend might reflect changes in incidence and poorer long-term survival in the period before World War II. The deceleration at around 1960 in birth cohort effects on the risk of developing the disease coincided with the last cohorts of women who had lived some years of their puberty in China. This generation of Hong Kong Chinese women grew up in a rapidly growing economy. Interestingly, the birth cohort around 1960s was at higher risk of developing the disease but at lower risk of death than previous generations. This might be explained by early detection and the availability of better treatment.

We projected a reduction in age-specific mortality for women aged ≤65 years, and a rising trend in mortality among women older than 65 years during 2010-25. In comparison with western countries that have had major socioeconomic transition in the more distant past, a reduction in mortality trends is observed in the younger age group (<50 years) in Hong Kong, regardless of the national screening level in young women.[5] This relatively larger reduction may reflect more effective cancer treatment and better response to treatment.[5] These same reasons could apply to the Hong Kong context. It is nonetheless unclear why mortality increased for much older women in Hong Kong. This could be attributed to a combination of less frequent diagnostic activity, less intensive treatment, and more frequent diagnosis of cancer at an advanced stage.[5] Increased mortality projection in older women suggests a need to investigate the underlying reasons and extend access to better treatment and medical technologies for all segments of the population whenever applicable.

There were limitations to the study. APC analyses are descriptive in nature. We can only speculate the aetiology of the changes observed. Nonetheless, our analyses can generate hypotheses about the relationship between cancer disease risk and potential risk factors. The reliability of APC analyses depends on the quality of the incidence and mortality data. The Hong Kong Cancer Registry is the most carefully validated source of data. Quality indicators suggest that our data quality matches international standards.

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Results of this study have been published in: Wong IO, Schooling CM, Cowling BJ, Leung GM. Breast cancer incidence and mortality in a transitioning Chinese population: current and future trends. Br J Cancer 2015;112:167-70.

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