

Trends in mortality from cancers of the breast, colon, prostate, esophagus, and stomach in East Asia: role of nutrition transition

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Although substantial nutrition transition, characterized by an increased intake of energy, animal fat, and red meats, has occurred during the last several decades in East Asia, few studies have systematically evaluated temporal trends in cancer incidence or mortality among populations in this area. Therefore, we sought to investigate this question with tremendous public health implications. Data on mortality rates of cancers of the breast, colon, prostate, esophagus, and stomach for China (1988–2000), Hong Kong (1960–2006), Japan (1950–2006), Korea (1985–2006), and Singapore (1963–2006) were obtained from WHO. Joinpoint regression was used to investigate trends in mortality of these cancers. A remarkable increase in mortality rates of breast, colon, and prostate cancers and a precipitous decrease in those of esophageal and stomach cancers have been observed in selected countries (except breast cancer in Hong Kong) during the study periods. For example, the annual percentage increase in breast cancer mortality was 5.5% (95% confidence interval: 3.8, 7.3%) for the period 1985–1993 in Korea, and mortality rates for prostate cancer significantly increased by 3.2% (95% confidence interval: 3.0, 3.3%) per year from 1958 to

1993 in Japan. These changes in cancer mortality lagged ~10 years behind the inception of the nutrition transition toward a westernized diet in selected countries or regions. There have been striking changes in mortality rates of breast, colon, prostate, esophageal, and stomach cancers in East Asia during the last several decades, which may be at least in part attributable to the concurrent nutrition transition. *European Journal of Cancer Prevention* 21:480–489 © 2012 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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Introduction

Large differences in cancer patterns exist between Asian and Western populations (Parkin, 2004; Jemal *et al.*, 2011). The incidence rates of breast, colon, and prostate cancers have been substantially higher in North America and Western Europe than in East Asia during the last several decades, whereas the opposite has been true for esophageal and stomach cancers (Parkin, 2004; Jemal *et al.*, 2011). For example, the age-standardized incidence of prostate cancer in 1993–1997 was only 3.0/100 000 for Chinese in Shanghai but it was 107.8/100 000 for US whites (Parkin *et al.*, 2002). During the same period, the incidence rate of stomach cancer was 32.3/100 000 for the former but only 6.6/100 000 for the latter (Parkin *et al.*, 2002).

A remarkable increase in the incidence rates of breast, colon, and prostate cancers and a concomitant decrease in the rates of esophageal and stomach cancers have been consistently observed among Asian immigrants to North America (Tominaga, 1985; Yu *et al.*, 1991). Of note, such changes in cancer risk are more pronounced among the descendants of immigrants (Ziegler *et al.*, 1993). The findings of these migrant studies suggest that adoption of a western lifestyle (especially dietary habits) may play

a critical role in the etiology of these cancers. The effects of dietary and other lifestyle factors on the risk of some of these malignancies have been reported in numerous epidemiologic studies (World Cancer Research Fund/American Institute for Cancer Research, 2007; Egeberg *et al.*, 2008; Engeset *et al.*, 2009; Hu *et al.*, 2011; Magalhaes *et al.*, 2011).

East Asia has experienced a rapid nutrition transition over the last several decades (Popkin and Du, 2003; Astrup *et al.*, 2008). This refers to a shift from a traditional Asian diet that is largely based on vegetal foods (high in carbohydrates and fiber) to a westernized diet that is principally composed of animal foods (high in total fat, saturated fat, and red/processed meat) (Food and Agriculture Organization, 1998; Popkin *et al.*, 2002; Popkin and Du, 2003). As a substantial body of evidence has linked diet to cancer (World Cancer Research Fund/American Institute for Cancer Research, 2007; Egeberg *et al.*, 2008; Engeset *et al.*, 2009; Hu *et al.*, 2011; Magalhaes *et al.*, 2011), such a nutrition transition might have resulted in a pronounced shift in cancer patterns in this geographic area. To our knowledge, however, no studies have comprehensively evaluated temporal trends in the

incidence or mortality of cancers of the breast, colon, prostate, esophagus, and stomach among these Asian populations. Therefore, we sought to investigate this question with tremendous public health implications using cancer mortality data obtained from WHO.

Materials and methods

Data sources

The numbers of deaths from cancers of the breast, colon, prostate, esophagus, and stomach by age and sex for China (except prostate), Hong Kong (a special administrative region of China), Japan, Korea, and Singapore were extracted from the WHO mortality database (www.who.int/healthinfo/morttables/en/index.html). The time period for the mortality data analyzed was 1988–2000 for China, 1960–2006 for Hong Kong, 1950–2006 for Japan, 1985–2006 for Korea, and 1963–2006 for Singapore. To calculate mortality rates, annual population estimates for the selected countries or regions over the study periods were also obtained from WHO. The calculated crude rates were age-standardized to the World Standard Population (Ahmad *et al.*, 2001). In this study, breast cancer was confined only to women. For China, colorectal cancer was evaluated as a single entity due to the lack of separate data for colon and rectal cancers. Singapore is classified into Southeast Asia by the United Nations but was treated as a country of East Asia in this paper because it shares dietary habits and culture with East Asian countries (Fung *et al.*, 1989).

To explore the effect of the nutrition transition on trends in cancer mortality, data on the consumption of energy, fat (vegetable and animal), meat, vegetables, fruits, and alcohol from 1961 to 2003 for China, Japan, and Korea were retrieved from the online Food Balance Sheet of the Food and Agriculture Organization (<http://faostat.fao.org/site/368/default.aspx>). The food consumption data for Hong Kong and Singapore were not available from this electronic database and were thus abstracted from the last printed version of the Food Balance Sheet (1964–1966 to 1994–1996 for Hong Kong and 1964–1966 to 1986–1988 for Singapore) (Food and Agriculture Organization, 1998). Cigarette consumption data were taken from WHO in 1970 and 2000 for China, Japan, and Korea and in 1980 and 2000 for Hong Kong and Singapore (Shafey *et al.*, 2003).

Statistical analysis

Temporal trends in cancer mortality for the five countries or regions examined were evaluated with the Joinpoint Regression Program (version 3.0) (Joinpoint Regression Program, 2005). The Joinpoint regression uses the grid search method to detect points at which significant changes in the direction and magnitude of trends over time occur under the assumption of constant variance and uncorrelated errors (Kim *et al.*, 2000). The Joinpoint regression analysis begins with no joinpoint and tests

whether one or more joinpoints (a maximum of three by default) are significant. The number of joinpoints needed to best describe the mortality trends for a given study period is determined by implementation of several permutation tests. This modeling technique offers estimated annual percentage change with a 95% confidence interval (CI) for each trend segment detected and also tests the statistical significance of the difference between the slopes of two consecutive trend segments (Kim *et al.*, 2000).

Changes (%) in the consumption of energy, nutrients, food items, alcohol, and cigarettes were estimated between the earliest and the latest years (or periods) considered.

Results

The analysis results of temporal trends in cancer mortality in East Asia are shown in Table 1. Trends in the mortality rates of breast, colon, prostate, esophageal, and stomach cancers are displayed in Figs 1–5, respectively. Breast cancer mortality overall increased in all countries except Hong Kong during the study periods. The increase started in the mid-1960s in Japan and Singapore and ~20 years later in China and Korea. A progressive increase was seen in both Japan (1962–2006) and Korea (1985–1993). The estimated annual percentage increase was 5.5% (95% CI: 3.8, 7.3%) for the period 1985–1993 in Korea. Except China and Korea, colon cancer mortality rapidly increased in most of the study periods for Hong Kong, Japan, and Singapore and began to decline in the mid-1990s in Hong Kong and Japan and in 2001 in Singapore. Although colorectal cancer mortality started to increase in 1996 in China, a significant upward trend in colon cancer mortality was observed throughout the study period (1985–2006) in Korea. A striking increase in prostate cancer mortality rates occurred during the last several decades in all countries or regions examined (except China, for which prostate cancer data were not available from WHO, probably due to low, unstable rates). For example, the rates significantly increased by 3.2% (95% CI: 3.0, 3.3%) per year from 1958 to 1993 in Japan. The rates began to level off in 1997 in Japan and to decrease in Singapore in 2000.

Esophageal cancer mortality rates reached a peak in 1979 for Hong Kong, in 1995 for Korea, and in 1970 for Singapore and declined thereafter. China has seen a monotonous decrease in the rates by 3.4% per year since 1988. Changes in the rates among the Japanese were not as pronounced as those of other populations. Compared with the other cancers of interest, a more consistent trend was observed for stomach cancer mortality. Except in 1950–1958 in Japan, the rates had been constantly declining over the entire study period for all countries or regions considered. In Japan, the rates had significantly decreased at a rate of 3.5% per year from 1970 to 1990.

The dietary habits of East Asian populations have substantially changed during the last several decades (Table 2).

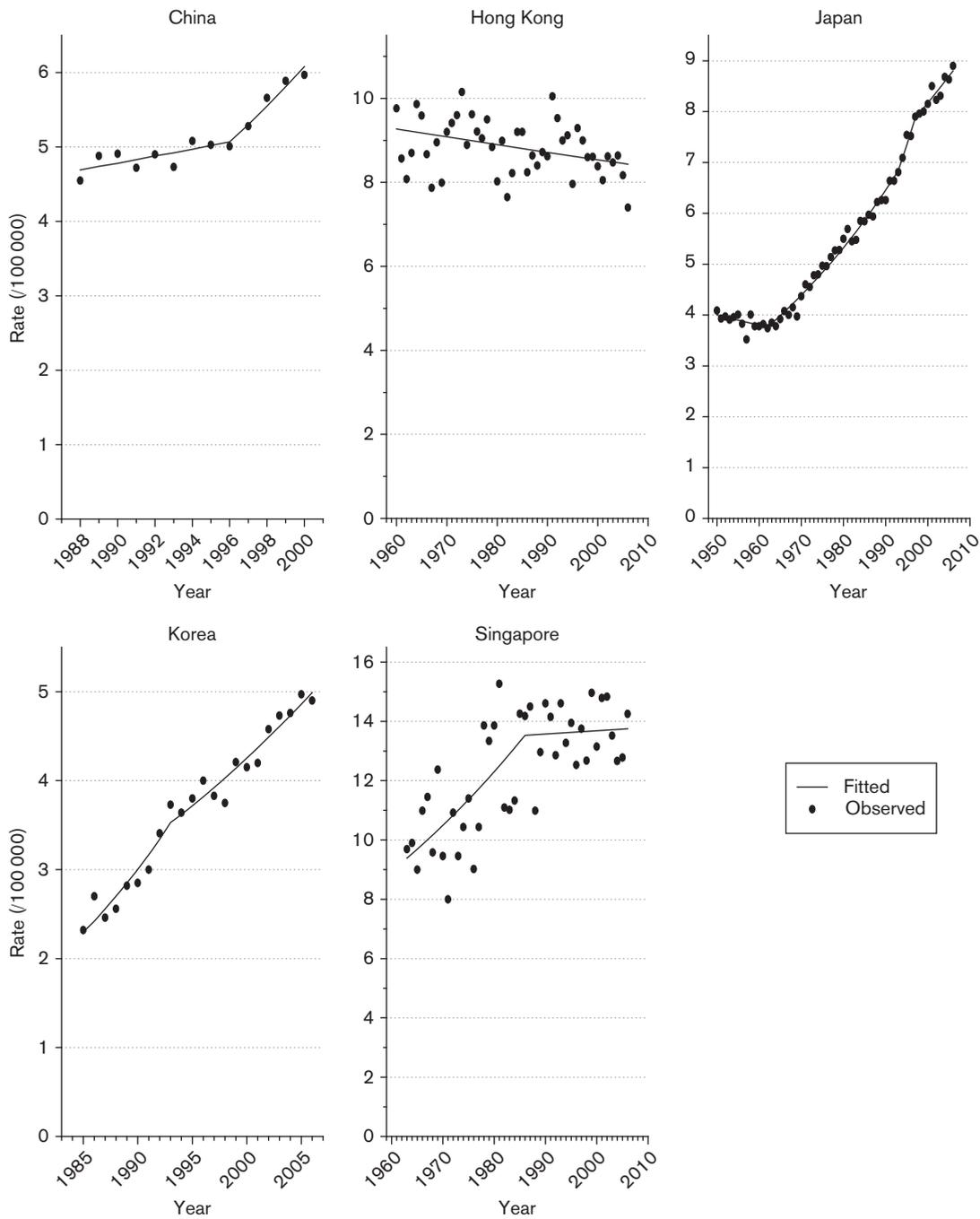
Table 1 Trends in age-standardized mortality rates of selected cancers in East Asian countries

	Trend 1 (T1)				Trend 2 (T2)			Trend 3 (T3)			Trend 4 (T4)	
	Rate change ^a	Year	EAPC (95% CI)	P for T1 vs. T2	Year	EAPC (95% CI)	P for T2 vs. T3	Year	EAPC (95% CI)	P for T3 vs. T4	Year	EAPC (95% CI)
China (1988–2000)												
Breast	4.6–6.0	1988–1996	1.0 (–0.04, 2.0)	0.015	1996–2000	4.6 (2.1, 7.3)	–	–	–	–	–	–
Colorectal	7.2–8.0	1988–1996	–0.24 (–0.53, 0.05)	0.000	1996–2000	2.8 (2.0, 3.6)	–	–	–	–	–	–
Esophagus	15.8–10.7	1988–2000	–3.4 (–4.0, –2.8)	–	–	–	–	–	–	–	–	–
Stomach	23.6–18.3	1988–2000	–2.6 (–3.4, –1.9)	–	–	–	–	–	–	–	–	–
Hong Kong (1960–2006)												
Breast	9.8–7.4	1960–2006	–0.20 (–0.36, –0.05)	–	–	–	–	–	–	–	–	–
Colon	5.7–8.5	1960–1974	2.1 (1.1, 3.1)	0.19	1974–1979	–1.0 (–5.4, 3.7)	0.20	1979–1995	2.0 (1.5, 2.5)	0.000	1995–2006	–0.56 (–1.1, –0.01)
Prostate	1.0–4.6	1960–2006	2.2 (1.7, 2.6)	–	–	–	–	–	–	–	–	–
Esophagus	4.2–3.1	1960–1979	1.6 (1.0, 2.2)	0.000	1979–1993	–2.0 (–2.8, –1.3)	0.000	1993–2006	–4.3 (–5.0, –3.5)	–	–	–
Stomach	14.5–5.0	1960–2003	–2.1 (–2.3, –2.0)	0.20	2003–2006	–7.0 (–14.1, 0.66)	–	–	–	–	–	–
Japan (1950–2006)												
Breast	4.1–8.9	1950–1962	–0.51 (–1.1, 0.13)	0.000	1962–1993	1.9 (1.8, 2.1)	0.22	1993–1997	3.6 (0.97, 6.2)	0.08	1997–2006	1.3 (0.82, 1.7)
Colon	2.6–7.4	1950–1953	–4.8 (–9.5, 0.13)	0.002	1953–1989	3.3 (3.2, 3.4)	0.000	1989–1996	1.9 (1.4, 2.4)	0.000	1996–2006	–1.1 (–1.3, –0.90)
Prostate	0.31–5.3	1950–1958	17.7 (14.3, 21.2)	0.000	1958–1993	3.2 (3.0, 3.3)	0.014	1993–1997	6.3 (3.8, 8.9)	0.000	1997–2006	–0.07 (–0.43, 0.29)
Esophagus	4.4–3.6	1950–1970	0.34 (0.15, 0.53)	0.000	1970–1984	–1.9 (–2.1, –1.6)	0.000	1984–2001	0.60 (0.42, 0.78)	0.000	2001–2006	–1.5 (–2.4, –0.59)
Stomach	49.1–14.3	1950–1958	0.96 (0.46, 1.5)	0.000	1958–1970	–0.89 (–1.2, –0.62)	0.000	1970–1990	–3.5 (–3.6, –3.4)	0.000	1990–2006	–3.1 (–3.2, –2.9)
Korea (1985–2006)												
Breast	2.3–4.9	1985–1993	5.5 (3.8, 7.3)	0.004	1993–2006	2.7 (2.2, 3.3)	–	–	–	–	–	–
Colon	1.5–5.7	1985–2000	9.0 (8.1, 9.9)	0.000	2000–2006	2.0 (0.16, 3.9)	–	–	–	–	–	–
Prostate	0.44–4.5	1985–2002	13.8 (12.4, 15.3)	0.000	2002–2006	1.9 (–2.7, 6.7)	–	–	–	–	–	–
Esophagus	2.8–2.4	1985–1995	2.6 (1.6, 3.7)	0.000	1995–2006	–3.5 (–4.3, –2.8)	–	–	–	–	–	–
Stomach	39.0–17.0	1985–1990	–4.6 (–6.4, –2.8)	0.13	1990–1993	1.7 (–6.4, 10.6)	0.11	1993–2006	–4.7 (–5.1, –4.3)	–	–	–
Singapore (1963–2006)												
Breast	9.7–14.3	1963–1986	1.6 (0.72, 2.5)	0.008	1986–2006	0.08 (–0.57, 0.74)	–	–	–	–	–	–
Colon	5.9–10.0	1963–1981	4.0 (2.8, 5.3)	0.000	1981–2001	0.81 (0.23, 1.4)	0.003	2001–2006	–4.2 (–7.3, –1.0)	–	–	–
Prostate	2.2–4.3	1963–2000	3.5 (2.5, 4.6)	0.004	2000–2006	–7.0 (13.5, –0.12)	–	–	–	–	–	–
Esophagus	7.7–1.6	1963–1970	3.5 (–1.2, 8.4)	0.001	1970–2001	–4.2 (–4.6, –3.7)	0.11	2001–2006	–10.2 (–17.2, –2.6)	–	–	–
Stomach	28.9–6.2	1963–1977	–1.5 (–2.4, –0.62)	0.002	1977–1998	–3.2 (–3.6, –2.7)	0.000	1998–2006	–6.80 (–8.6, –5.0)	–	–	–

95% CI, 95% confidence interval; EAPC, estimated annual percentage change.

^aAge-standardized rates (by the World Standard Population) of the beginning and ending years of the study period.

Fig. 1



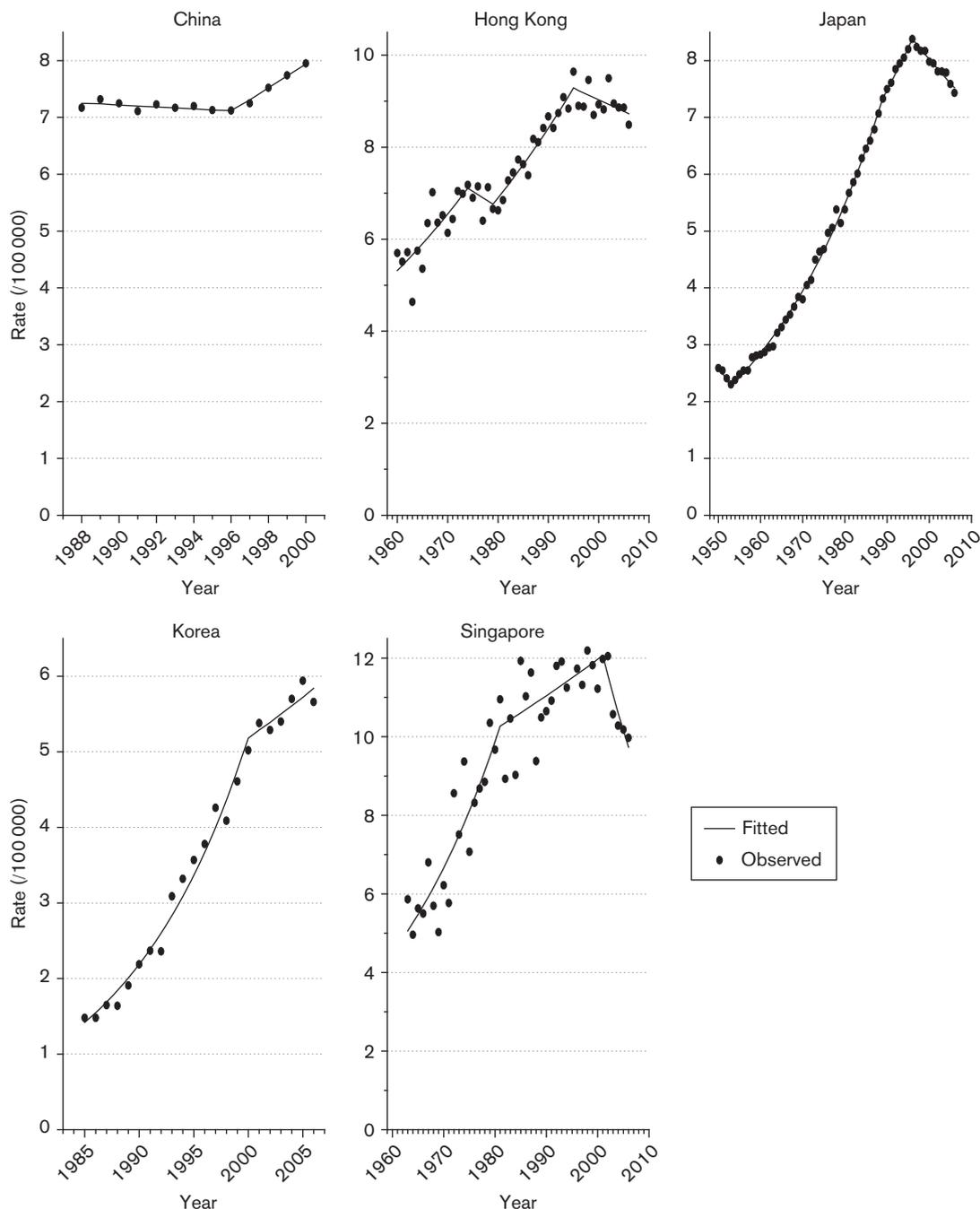
Trends in age-standardized mortality rates of female breast cancer in East Asian countries.

The most notable changes were increased consumption of energy, fat, and meats. For example, consumption of animal fat from 1961 to 2003 increased by approximately six-fold in both China and Korea. In the period 1970–2000, per capita cigarette consumption increased in China (129%) and Korea (25.2%) but decreased in Hong Kong (22.3%) and Singapore (15.8%) (Table 3).

Discussion

The present study demonstrates that selected countries or regions in East Asia have witnessed dramatic changes in cancer patterns during the last several decades. An overall upward trend was observed in mortality from breast, colon, and prostate cancers (major cancers in Western countries), except breast cancer in Hong Kong,

Fig. 2



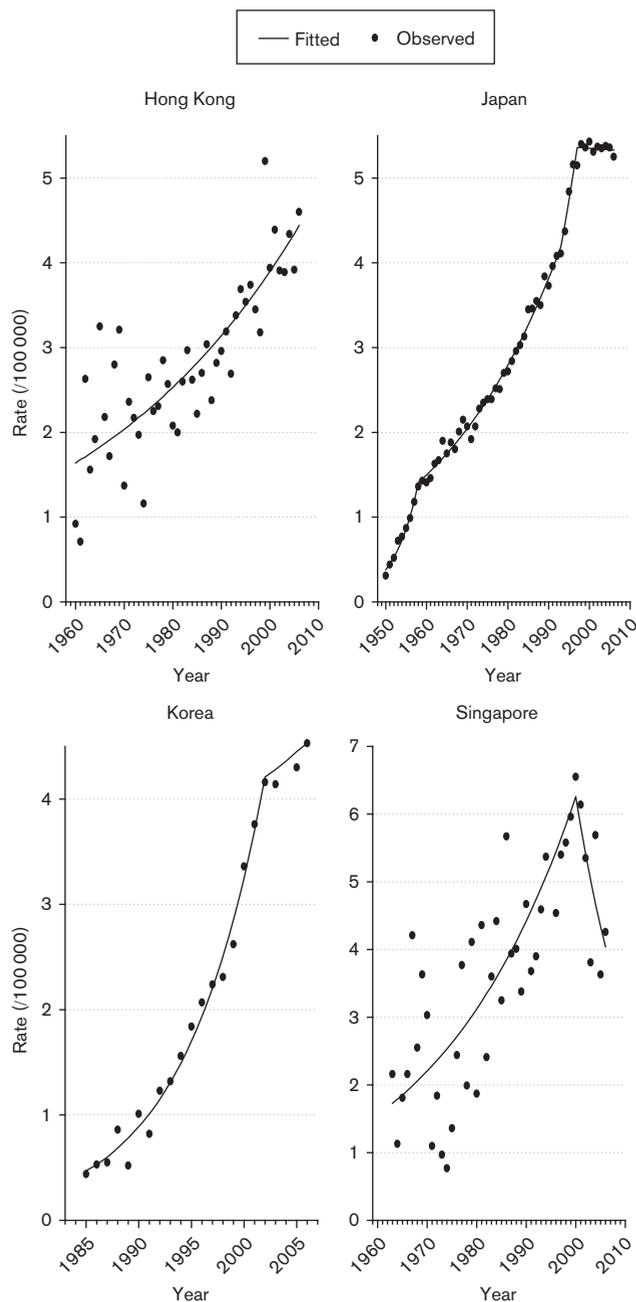
Trends in age-standardized mortality rates of colon cancer in East Asian countries.

whereas a general downward trend was found in mortality from esophageal and stomach cancers (major cancers in East Asian countries).

Incidence rates of breast, colon, and prostate cancers are remarkably higher in Western populations than in Asian populations (Parkin, 2004; Jemal *et al.*, 2011). A number of epidemiologic studies suggest that the risk of these

cancers is associated with a westernized diet and a sedentary lifestyle (World Cancer Research Fund/American Institute for Cancer Research, 2007; Egeberg *et al.*, 2008; Wolin *et al.*, 2009; Magalhaes *et al.*, 2011). Our analysis indicated that mortality rates of these malignancies began to increase in the 1950s–1960s in Japan, the mid-1960s in Singapore, the mid-1980s in Korea, and the late 1980s in China (except colon cancer). These

Fig. 3



Trends in age-standardized mortality rates of prostate cancer in East Asian countries.

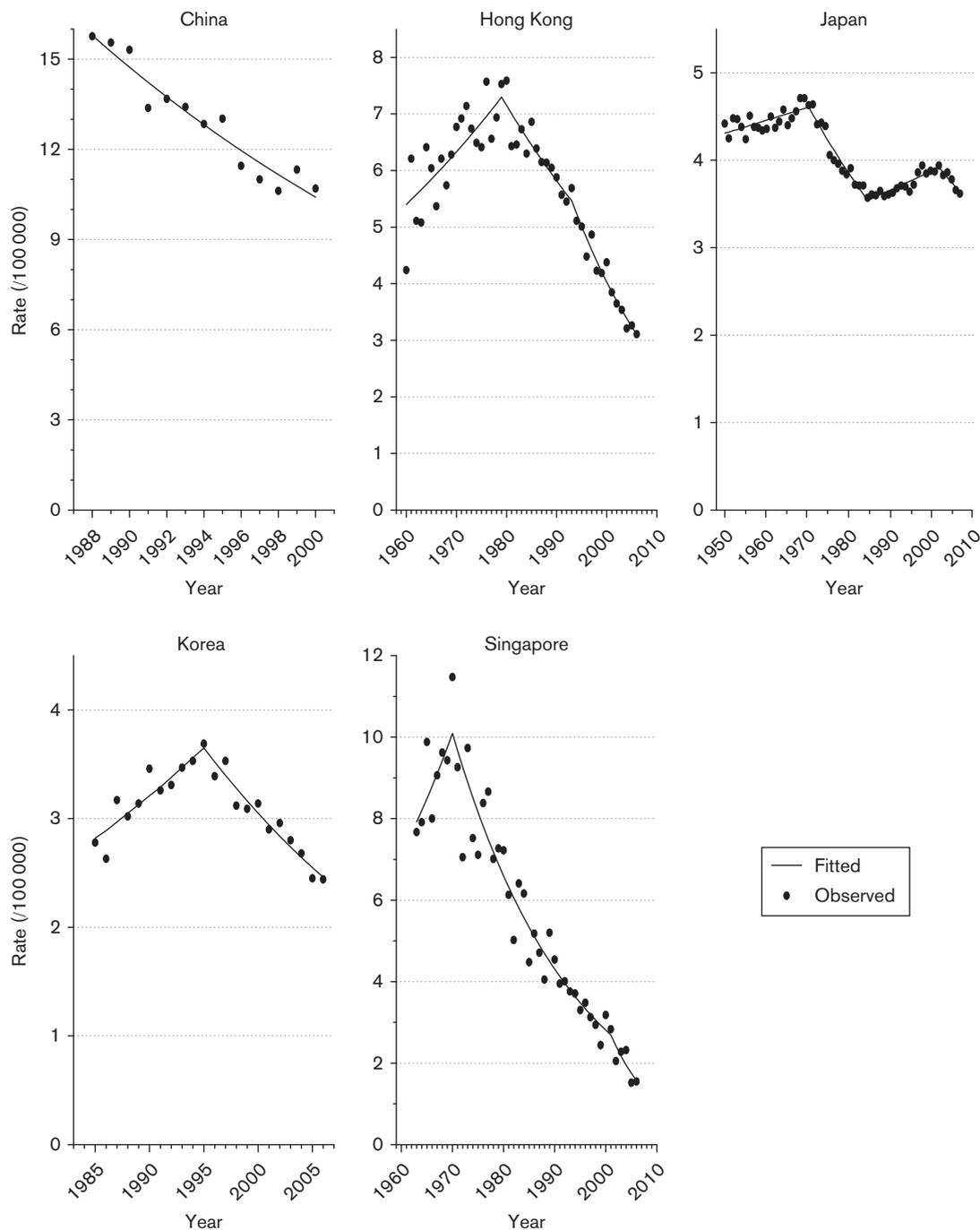
changes occurred ~10 years after the inception of the nutrition transition primarily due to the rapid economic growth in these countries, suggesting a latency period for the effect of dietary modifications on the development of breast, colon, and prostate cancers. For instance, the initiation of economic reforms in 1978 in China has led to a substantial economic growth and a considerable increase in the average family income over the last three decades

(Zhai *et al.*, 2009). Consequently, these socioeconomic changes have triggered a profound shift from a traditional Chinese diet to a westernized diet (Popkin and Du, 2003; Zhai *et al.*, 2009). According to the China Health and Nutrition Survey, energy intake from fat increased from 21.4 to 32.8% during an 8-year period (1989–1997) among urban adults (Popkin and Du, 2003). The Food and Agriculture Organization data on trends in food consumption (Table 2) clearly show that other countries or regions in East Asia have experienced a similar nutrition transition during the last several decades.

Overweight and obesity prevalence has also increased during the same time periods in our study populations due to elevated energy intake and reduced physical activity (Lee and Sobal, 2003; Zhai *et al.*, 2009). Therefore, it is reasonable to infer that the observed trends in mortality from breast, colon, and prostate cancers in the countries or regions under study are at least in part attributable to the nutrition transition and the subsequent increase in the prevalence of overweight and obesity (Popkin, 2004). Unexpectedly, a slight but significant decline in breast cancer mortality was seen from 1960 to 2006 in Hong Kong. No reasonable explanations are available for this epidemiologic phenomenon.

Other risk factors may also be responsible for the observed changes in mortality from breast, colon, and prostate cancers in East Asia. From 1970 to 2000, per capita cigarette consumption increased by 129% in China, by 25.2% in Korea, and by 7.6% in Japan. However, epidemiologic studies have shown an inconsistent or a weak effect of cigarette smoking on the risk of these cancers (Lumey, 1996; Terry and Rohan, 2002; Botteri *et al.*, 2008). A modest association was found between alcohol intake and the risk of breast and colon cancers in most case-control and cohort studies (Hamajima *et al.*, 2002; Mizoue *et al.*, 2006). It is thus possible that increased alcohol intake in China (1150%) and Korea (139%) might account for a proportion of the elevated risk of death from these two cancers during the study periods. Reproductive factors and exogenous hormone use have been consistently linked to breast cancer. Specifically, increased risk has been associated with early menarche, late menopause, nulliparity, use of oral contraceptives, and hormone replacement therapy (Rossouw *et al.*, 2002; Iwasaki *et al.*, 2007; Hunter *et al.*, 2010). In China, the mean birth rate decreased from 5.9 births per woman in 1970 to 1.7 births per woman in 2004 (Hesketh *et al.*, 2005), and the mean age at menarche decreased from 16.5 years in the 1940s to 13.9 years in the 1980s (Chen *et al.*, 2006). The WHO MONICA project revealed that the proportions of women who used oral contraceptives or received hormone replacement therapy were much lower in China than in most Western countries (Lundberg *et al.*, 2004). Although data on secular trends in these hormone-related risk factors are scarce for selected countries or regions, changes in some of

Fig. 4



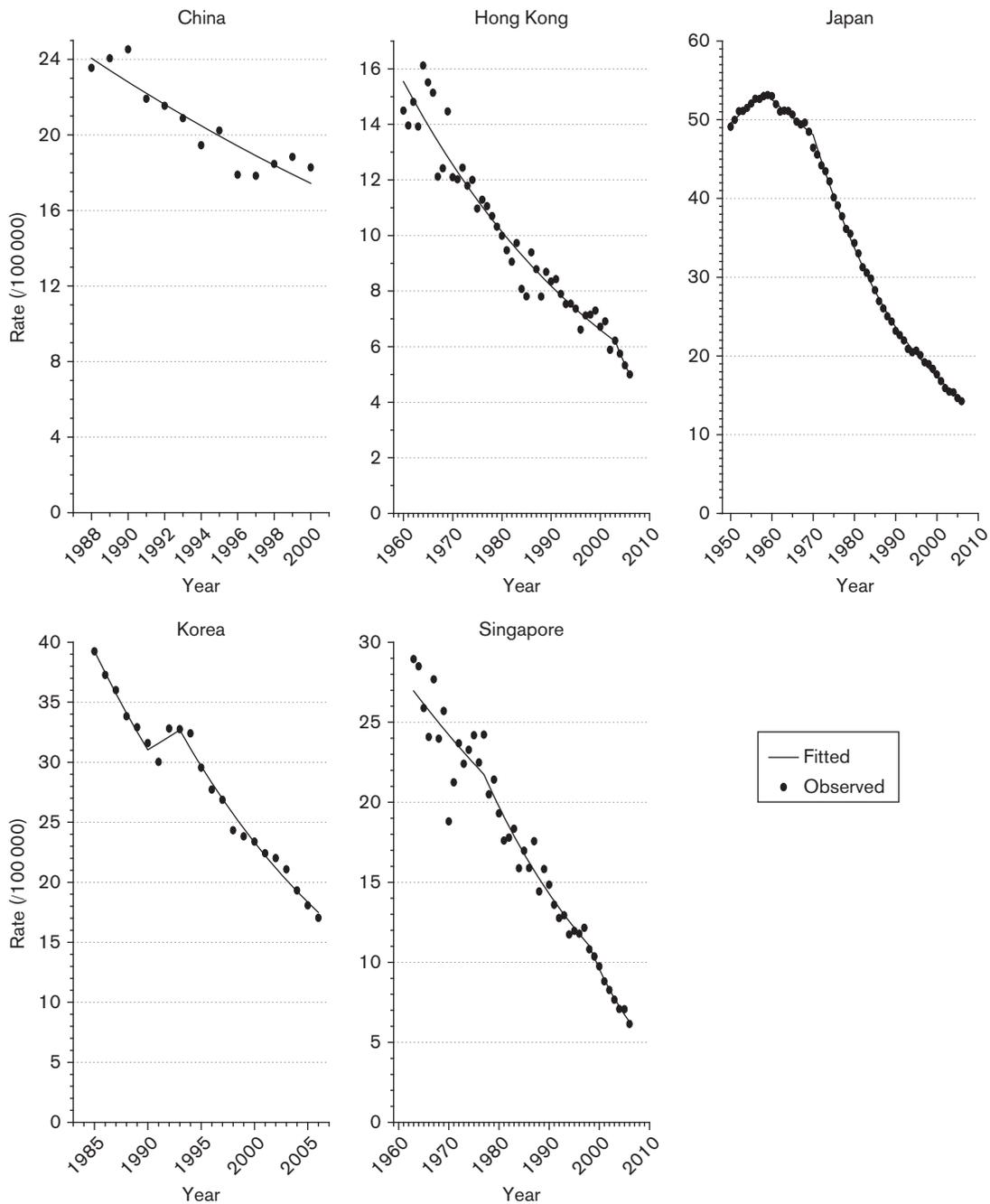
Trends in age-standardized mortality rates of esophageal cancer in East Asian countries.

these exposures might have modified the incidence and mortality of breast cancer among East Asian women.

Esophageal and stomach cancers present a tremendous public health burden in Asia. Cigarette smoking and alcohol intake confer a risk for esophageal cancer (Hashibe *et al.*, 2007), whereas intake of vegetables and fruits reduces the risk (Freedman *et al.*, 2007; Yamaji *et al.*, 2008).

The decline in esophageal cancer mortality in China, Korea, and Singapore over the last several decades may be partially attributable to increased intake of vegetables and fruits, rich sources of antioxidants, and other anticarcinogenic micronutrients (e.g. isothiocyanates) (Freedman *et al.*, 2007; Yamaji *et al.*, 2008). The simultaneous increase in alcohol and tobacco consumption might have decelerated the decrease of this cancer in China.

Fig. 5



Trends in age-standardized mortality rates of stomach cancer in East Asian countries.

Helicobacter pylori infection and high salt intake have been consistently associated with stomach cancer risk in diverse populations (Aromaa *et al.*, 1996; Joossens *et al.*, 1996; Hu *et al.*, 2011). The synergistic effect between these risk factors was observed in both animal and human epidemiologic studies (Nozaki *et al.*, 2002; Lee *et al.*, 2003). This interaction is biologically plausible because the gastric mucosa damage caused by a high salt diet facilitates the colonization of *H. pylori* in the stomach

(Nozaki *et al.*, 2002; Lee *et al.*, 2003). A sharp decline in stomach cancer mortality has occurred in the last several decades in all the countries or regions examined. This downward trend may be largely driven by a marked decrease in salt consumption due to the introduction of refrigerators in ordinary households in the 1960s–1970s in Japan, Hong Kong, and Singapore and in the 1980s in China (Matsumura, 2001; Zhai *et al.*, 2009). For example, the Economic, Population, Nutrition, and Health Survey

Table 2 Trends in per capita consumption of food and alcohol in East Asian countries

Country	Year	Energy	Fat (%E)				Meat (g/d)	Vegetables (g/d)	Fruit (g/d)	Alcohol (%E)
			Total	Animal	Vegetal	A/V				
China	1961	1641	8.3	2.4	5.9	0.41	3.8	78.8	4.3	0.52
	2003	2940	29.5	16.6	12.9	1.28	54.8	270.5	49.7	6.5
	% Change	79.2	255	591.7	118.6	212.2	1342	243.3	1056	1150
Hong Kong	1964–1966	2666	26.8	14.8	12.1	1.22	57.5	181	125	1.50
	1994–1996	3261	38.6	19.8	18.8	1.06	137.1	142	281	1.84
	% Change	22.3	43.8	34.3	55.3	-13.5	138	-21.8	125	22.6
Japan	1961	2468	12.1	4.9	7.2	0.68	7.5	95.1	29.2	8.3
	2003	2768	28.0	11.2	16.8	0.67	43.5	104.6	54.8	12.5
	% Change	12.2	131.4	128.6	133	-1.5	480	10.0	87.7	50.6
Korea	1961	2147	6.3	1.4	4.9	0.29	4.1	75.9	5.2	6.7
	2003	3035	24.6	9.5	15.1	0.63	51.0	211.4	63.7	16.0
	% Change	41.4	290.5	578.6	208.2	117.2	1144	178.5	1125	138.8
Singapore	1964–1966	2301	16.2	11.3	4.9	2.31	-	164	144	1.04
	1986–1988	2882	25.3	16.7	8.6	1.94	-	330	296	1.08
	% Change	25.2	56.0	47.5	75.6	-16.0	-	101.8	105.1	3.13

A/V, ratio of animal fat to vegetal fat; %E, percent of total energy.

Table 3 Trends in per capita cigarette consumption in East Asian countries

Country	Cigarette consumption (cigarettes/capital/year)		
	1970 ^a	2000	Change (%)
China	782	1790	129
Hong Kong	3195	2484	-22.3
Japan	2810	3023	7.6
Korea	2145	2686	25.2
Singapore	2741	2309	-15.8

^aThe only year in which cigarette consumption data were available for Hong Kong and Singapore was 1980.

in China revealed that the average salt intake of adults rapidly decreased from 19 g/day in 1989 to 10 g/day in 2004 (Zhai *et al.*, 2009). The effect of changes in the prevalence of *H. pylori* infection on trends in stomach cancer mortality could not be estimated because national representative data on this risk factor are not available. However, improved hygiene and living conditions resulting from socioeconomic development might have reduced the risk of *H. pylori* infection and thereby contributed to the decline in stomach cancer mortality in these Asian populations to some extent.

The present study has some advantages. Temporal trends in mortality from five common cancers over an extended period of time were evaluated in five countries or regions of East Asia. Both the magnitude and the direction of changes in mortality rates over time were estimated using Joinpoint regression analysis and were interpreted in terms of concomitant changes in dietary and other life-style factors in these Asian populations.

Our study is also subject to some limitations. Unlike incidence, mortality is not a measure of disease risk because it can be affected by factors associated with survival (e.g. treatment, screening, tumor biology). For esophageal and stomach cancers, however, mortality is an approximate estimate of its incidence due to the rapidly fatal nature of these malignancies (Yang, 2006; Bosetti *et al.*, 2008).

Advances in medical treatment and implementation of screening programs may partially account for the decline in mortality rates for colon and prostate cancers in the 2000s in some of our study populations. Cancer mortality data in China may not be well representative of its entire population because they were only based on selected urban and rural areas. The coverage and accuracy of cancer death registration might have somewhat changed during the study periods in some of the selected populations. For example, it is likely that missing and erroneous information on the cause of death was more serious during early study periods. Such changes over time in the quality of mortality data could have reduced the validity of our obtained results of temporal trends. Attention should be paid to potential changes in the coding schemes of the WHO International Classification of Diseases (ICD). During the study periods, the sites of cancer examined were coded with more than one ICD revision in all selected countries or regions (e.g. ICD-7 to ICD-10 in Hong Kong and Japan), except China (ICD-9 only). Although codes for each of the five cancers evaluated vary with ICD revisions, the definitions of these cancers remained unchanged for all the revisions involved (www.who.int/healthinfo/morttables/en/index.html). Finally, the scarcity of national data on risk factors for some cancers of interest compromises our ability to interpret the obtained results.

In summary, East Asia has experienced remarkable changes in cancer mortality during the last 3–5 decades. With a few exceptions, mortality rates of breast, colon, and prostate cancers have increased but the rates of esophageal and stomach cancers have decreased. Such substantial changes may be at least in part ascribed to simultaneous nutrition transition and other lifestyle factors as a result of rapid socioeconomic development in this geographic area. An accurate description of trends in mortality of these cancers and a deep understanding of the causes of these changes are expected to contribute to the elucidation of the etiology of and

thereby the formulation of prevention measures for these malignancies.

Acknowledgements

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Conflicts of interest

There are no conflicts of interest.

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