**Name of journal:** *World Journal of Gastroenterology*

**ESPS Manuscript NO: 579**

**Columns: TOPIC HIGHLIGHT**

**Jung Eun Lee, ScD, Assistant Professor,** *Series Editor*

**Colorectal cancer mortality in Hong Kong of China, Japan, South Korea, and Singapore**

Shin A *et al*. Colorectal cancer mortality in Asia

Aesun Shin, Kyu Won Jung, Young-Joo Won

**Aesun Shin,** Molecular Epidemiology Branch, Division of Cancer Epidemiology and Prevention, National Cancer Center Research Institute, 323 Ilsan-ro, Ilsandong-gu, Goyang-si 410-769, South Korea

**Aesun Shin, Kyu Won Jung, Young-Joo Won,** Cancer Registration and Statistics Branch, National Cancer Control Institute, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang-si 410-769, South Korea

**Author contributions:** Shin A, Jung KW and Won YJ solely contributed to this paper.

**Supported by** Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Education, Science and Technology, 2010-0010276; A Research Grant from the National Cancer Center of Korea, 1010160

**Correspondence to: Kyu Won Jung, Branch Chief,** Cancer Registration and Statistics Branch, National Cancer Control Institute, National Cancer Center, 323 Ilsanro, Ilsandong-gu, Goyang-si 410-769, South Korea. ara@ncc.re.kr

**Telephone:** +82-31-9202170  **Fax:** +82-31-9202179

**Received:** September 19, 2012  **Revised:** January 8, 2013

**Accepted:** January 23, 2013

 **Published online:**

**Abstract**

To clarify the trend in colorectal cancer mortality in Asian countries. We analyzed the colorectal cancer mortality in four Asian countries using the World Health Organization mortality database and the Korea National Statistics Office database. The annual age-standardized rates and truncated rated for the three age groups (30-49, 50-69 and ≥ 70 years) for Hong Kong (1969-2009), Japan (1955-2009), Korea (1985-2006), and Singapore (1966-2009) were estimated. A joinpoint regression model was used to detect significant trends in mortality rates. Colorectal cancer mortality in men started to decrease in 1992 in Japan followed by Singapore and Hong Kong in 1995. The mortality rates in women stared to decrease in 1980 in Singapore, followed by Hong Kong and Japan in 1996. In all countries and both genders, except for women in Singapore, the decrease in mortality began in the younger age groups. The colorectal cancer mortality in the four studied Asian countries has started to decrease, and the decrease occurred first in the younger age groups.

© 2013 Baishideng. All rights reserved.

**Key words:** Colorectal cancer; Mortality; Joinpoint regression; Trends; Early detection of cancer; Mass screening

Shin A, Jung KW, Won YJ. Colorectal cancer mortality in Hong Kong of China, Japan, South Korea, and Singapore.

*World J Gastroenterol* 2013;

**Available from:** URL: http://www.wjgnet.com/esps/

**DOI:** http://dx.doi.org/10.3748/wjg.v19.i0.0000

**INTRODUCTION**

Colorectal cancer is responsible for 8% of all cancer deaths worldwide, with an estimated 608 000 deaths annually, and it is ranked as the fourth most common cause of death from cancer [1]. It has been estimated that the numbers of deaths due to colorectal cancer will reach approximately 376 700 by 2020 in Asia [1].

A decline in colorectal cancer mortality has been observed in most western and northern European countries [2] and the United States [3]. Among Asian countries, the mortality started to decrease in the early 1990s in Japan [4, 5]. The trends in colorectal mortality differ by geographic region, sex, and age group [6]. In this review, we analyzed the trends in colorectal cancer mortality in 4 Asian countries stratified by sex and age groups.

**DATA ANALYSIS**

Colorectal cancer mortality data were extracted from the World Health Organization (WHO) mortality database [7]. The 3 countries or regions with data available for the longest period were Japan (since 1955), Singapore (since 1966) and Hong Kong (since 1969) and were included in the analysis. In addition, Korean data were available from the WHO mortality database for 1985 to 2006 and from the Korea National Statistics Office (NSO) for 2007 to 2010 and were included in the study [8]. The annual age-standardized rates (ASR) and the truncated rates for the 3 age groups (30-49, 50-69 and ≥ 70 years) were estimated using the world standard population.

The trends in colorectal cancer mortality were tested using joinpoint regression models, using Joinpoint software version 3.5.3. The software was developed by the Surveillance Research Program of the US National Cancer Institute and is based on the Poisson assumption [9]. A maximum of 3 joinpoints was allowed, and the default settings were used.

Table 1 shows the age-adjusted mortality rates for colorectal cancer in the 4 countries. Singapore showed the highest female mortality rates of the 4 countries from 1966 to 2009. Singapore also showed the highest male mortality during the same period, except for 2005, when males in Hong Kong showed a slightly higher rate. Korean men and women showed the lowest rates among the 4 countries.

Table 2 shows the results for the joinpoint regression analyses. Colorectal cancer mortality in men started to decrease in 1992 in Japan, followed by Singapore and Hong Kong in 1995. The mortality rates in women stared to decrease in 1980 in Singapore, followed by Hong Kong and Japan in 1996. In Korea, the mortality rates plateaued in 2002 in men and started to decrease in 2004 in women.

 In men, the decline in mortality started for younger age groups first. In Japan, mortality started to decrease in 1977 for the 30-49 years age group, in 1995 for the 50-69 years age group, and in 1998 for the 70 and older age group (Table 2). A similar trend was observed for Hong Kong, Singapore and Korea. Similarly, a significant decrease in APC was first observed for younger age groups in Hong Kong, Japan and Korea in women. For example, in Hong Kong, female mortality began to decrease in 1992 for the 30-49 years age group, in 1994 for the 50-69 years age group, and in 2002 for the 70 years and older age group. Whereas, for women in Singapore, the decrease began in 1980 in the 50-69 years age group, which was 4 years earlier than among the 30-49 years age group (Table 2). Figure 1 shows the trends in colorectal cancer mortality rates for the 3 age groups in Hong Kong, Japan, Korea, and Singapore between 1955 and 2010.

**DISCUSSION**

Colorectal cancer mortality in the European Union has declined since the early 1980s. These decreases were observed in most western and northern European countries, whereas a persistent excess in mortality was observed in Hungary and the Czech Republic [6]. In the United States, colorectal cancer mortality rates in white men began to decline in 1978 [10]. The APC for white men was -0.6% between 1973 and 1978 and -2.0% in 1986 [10]. The decline in the mortality of white women was more rapid, with an APC of -2.1% between 1973 and 1997 [10].

In Asia, a reduction in colorectal cancer mortality has been observed for economically advanced regions, such as Japan, Hong Kong, Singapore, and more recently, in Korea. Notably, the decline started in younger age groups. A more favorable mortality trend and a consequent widening of the survival gap between the elderly and middle age groups were observed in Europe [2, 6, 11].

In contrast, the incidence rates for colorectal cancer in these countries have increased, except for men and women in Japan and women in Hong Kong [4, 12-14]. Singapore experienced a sharp increase in the colorectal cancer incidence between 1968 and 2002, particularly among older men [12]. In Hong Kong, the ASR peaked in 1994 and has since declined in women, whereas the ASR progressively increased in men [14]. The increase was notable among men above 60 years old and women above 70 years old [14]. Similarly, the APCs for the incidence rate of colorectal cancer was prominent among older Korean men and women between 1999 and 2009 [13]. Japan is the only Asian country in which the incidence rates for colorectal cancer have decreased in both men and women [4]. The Osaka Cancer Registry data showed that the overall colorectal cancer incidence in women has decreased since 1995. In men, the rate has been stabilized since 1996 [9].

Changes in risk factors, particularly those related to lifestyle, have been suspected as main contributors to the colorectal cancer increase. Among modifiable lifestyle factors, alcohol consumption, obesity, cigarette smoking, and dietary habits (*e.g.*, red meat and processed meat consumption) have been associated with colorectal cancer risk [15, 16]. In a study for population-attributable fractions of cancer in Japan, 31%-33% of the colorectal cancer incidence or mortality was explained by known preventable risk factors, such as alcohol consumption, cigarette smoking, obesity, and physical inactivity [17] when men and women combined. Among them, alcohol consumption was attributed for the greatest portion, followed by cigarette smoking and obesity. In a Chinese study, the population-attributable fraction of known preventable risk factors for cancer death was 14.6% for colon cancer and 2.2% for rectal cancer [18]. Alcohol consumption was accountable for 32.9% of male colorectal cancer and 2.1% of female colorectal cancer in Japan [17]. In China, alcohol consumption was accountable for 2.1% and 0.2% of colorectal cancer cases in men and women, respectively [19]. The prevalence and amount of alcohol consumption in these countries and Korea have not decreased during the last few decades [17, 18, 20]. However, the prevalence of obesity, particularly in men, and a sedentary lifestyle has increased in Hong Kong, Korea, and Japan [14, 17, 21]. Fortunately, the prevalence of cigarette smoking has declined in Korea, Japan, and China [17, 18, 20]. These changes may explain the transition in the colorectal cancer epidemiology in these Asian countries.

A rapid increase in the incidence among older age groups may reflect the accumulated exposure to risk factors [22]. In contrast, a major contributor to the mortality reduction for colorectal cancer in the younger generation is the adaptation of screening programs. In Japan, a colorectal cancer screening program using a fecal occult blood test (FOBT) has been in place since 1992 under the Health Services Law for the Aged [23]. Colorectal cancer screening programs were introduced as a part of the National Cancer Screening Program for Medical Aid recipients and National Health Insurance beneficiaries in the lower income bracket in 2004 in Korea [24]. The FOBT is provided free of charge as a primary modality for men and women aged 50 years or older. FOBT-positive individuals were provided follow up by either colonoscopy or a double-contrast barium enema [24]. According to the Korean National Cancer Screening Survey, which covers both organized and opportunistic cancer screening programs, the lifetime screening rates for colorectal cancer were 25.3% in 2004 and 54.2% in 2010 [25]. Although colorectal cancer screening for the average-risk population is recommended to start at 50 years of age, a national screening program is not available in Singapore [26]. However, compliance with opportunistic screening in Singapore was reasonably high [26].

**CONCLUSION**

In 4 Asian countries in which economic development and the westernized lifestyle were adopted early, colorectal cancer mortality has started to decrease. The decline or stabilization of mortality occurred the earliest in younger age groups and in women. The most important contributor to the decline in mortality is the introduction of colorectal cancer screening programs, although the role of the transition of lifestyle risk factors needs to be addressed.

**REFERENCES**

1 **Ferlay J**, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. GLOBOCAN 2008 v1.2, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 10. 2010 25/7/2011. Available from: http: //globocan.iarc.fr

2 **Bosetti C**, Levi F, Rosato V, Bertuccio P, Lucchini F, Negri E, La Vecchia C. Recent trends in colorectal cancer mortality in Europe. *Int J Cancer* 2011; **129**: 180-191 [PMID: 20824701 DOI: 10.1002/ijc.25653.]

3 **Jemal A**, Siegel R, Xu J, Ward E. Cancer statistics, 2010. *CA Cancer J Clin* 2010; **60**: 277-300 [PMID: 20610543 DOI: caac.20073]

4 **Ito Y**, Ioka A, Nakayama T, Tsukuma H, Nakamura T. Comparison of trends in cancer incidence and mortality in Osaka, Japan, using an age-period-cohort model. *Asian Pac J Cancer Prev* 2011; **12**: 879-888 [PMID: 21790220]

5 **Qiu D**, Katanoda K, Marugame T, Sobue T. A Joinpoint regression analysis of long-term trends in cancer mortality in Japan (1958-2004). *Int J Cancer* 2009; **124**: 443-448 [PMID: 18844218 DOI: 10.1002/ijc.23911.]

6 **La Vecchia C**, Bosetti C, Lucchini F, Bertuccio P, Negri E, Boyle P, Levi F. Cancer mortality in Europe, 2000-2004, and an overview of trends since 1975. *Ann Oncol* 2010; **21**: 1323-1360 [PMID: 19948741 DOI: 10.1093/annonc/mdp530.]

7 **World Health Organization Statistical Information System.** WHO mortality database [updated July 9, 2012; cited 2012 Jul 31]. Available from: http: //www.who.int/healthinfo/morttables/en/

8 **Korean Statistical Information Service**. Korea National Statistical Office (available at http: //www.kosis.kr). [cited 2011.7.21]. Available from: http: //www.kosis.kr/

9 **National Cancer Institute.** Joinpoint Regression Program version 3.5.3 2012 [Aug 6, 2012]. Available from: http: //surveillance.cancer.gov/joinpoint/.

10 **Ries LA**, Wingo PA, Miller DS, Howe HL, Weir HK, Rosenberg HM, Vernon SW, Cronin K, Edwards BK. The annual report to the nation on the status of cancer, 1973-1997, with a special section on colorectal cancer. *Cancer* 2000; **88**: 2398-2424 [PMID: 10820364 DOI: 10.1002/(SICI)1097-0142(20000515)88: 10<2398: : AID-CNCR26>3.0.CO; 2-I]

11 **Quaglia A**, Tavilla A, Shack L, Brenner H, Janssen-Heijnen M, Allemani C, Colonna M, Grande E, Grosclaude P, Vercelli M. The cancer survival gap between elderly and middle-aged patients in Europe is widening. *Eur J Cancer* 2009; **45**: 1006-1016 [PMID: 19121578 DOI: 10.1016/j.ejca.2008.11.028.]

12 **de Kok IM**, Wong CS, Chia KS, Sim X, Tan CS, Kiemeney LA, Verkooijen HM. Gender differences in the trend of colorectal cancer incidence in Singapore, 1968-2002. *Int J Colorectal Dis* 2008; **23**: 461-467 [PMID: 18185939 DOI: 10.1007/s00384-007-0421-9.]

13 **Jung KW**, Park S, Kong HJ, Won YJ, Lee JY, Seo HG, Lee JS. Cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2009. *Cancer Res Treat* 2012; **44**: 11-24 [PMID: 22500156 DOI: 10.4143/crt.2012.44.1.11.]

14 **Yee YK**, Gu Q, Hung I, Tan VP, Chan P, Hsu A, Pang R, Lam CS, Wong BC. Trend of colorectal cancer in Hong Kong: 1983-2006. *J Gastroenterol Hepatol* 2010; **25**: 923-927 [PMID: 20074150 DOI: 10.1111/j.1440-1746.2009.06130.x.]

15 **Chan AT**, Giovannucci EL. Primary prevention of colorectal cancer. *Gastroenterology* 2010; **138**: 2029-2043.e10 [PMID: 20420944 DOI: 10.1053/j.gastro.2010.01.057.]

16 **Shin A**, Joo J, Bak J, Yang HR, Kim J, Park S, Nam BH. Site-specific risk factors for colorectal cancer in a Korean population. *PLoS One* 2011; **6**: e23196 [PMID: 21853085 DOI: 10.1371/journal.pone.0023196PONE-D-11-07835]

17 **Inoue M**, Sawada N, Matsuda T, Iwasaki M, Sasazuki S, Shimazu T, Shibuya K, Tsugane S. Attributable causes of cancer in Japan in 2005--systematic assessment to estimate current burden of cancer attributable to known preventable risk factors in Japan. *Ann Oncol* 2012; **23**: 1362-1369 [PMID: 22048150 DOI: 10.1093/annonc/mdr437.]

18 **Wang JB**, Jiang Y, Liang H, Li P, Xiao HJ, Ji J, Xiang W, Shi JF, Fan YG, Li L, Wang D, Deng SS, Chen WQ, Wei WQ, Qiao YL, Boffetta P. Attributable causes of cancer in China. *Ann Oncol* 2012; **23**: 2983-2989 [PMID: 22689178 DOI: 10.1093/annonc/mds139.]

19 **Liang H**, Wang J, Xiao H, Wang D, Wei W, Qiao Y, Boffetta P. Estimation of cancer incidence and mortality attributable to alcohol drinking in China. *BMC Public Health* 2010; **10**: 730 [PMID: 21108783 DOI: 10.1186/1471-2458-10-730.]

20 **Shin A**, Cho ER, Kim J, Sung J, Park KW, Lim MK, Shin HR. Factors associated with awareness of infection status among chronic hepatitis B and C carriers in Korea. *Cancer Epidemiol Biomarkers Prev* 2009; **18**: 1894-1898 [PMID: 19454614 DOI: 10.1158/1055-9965.EPI-08-1228.]

21 **Ministry of Health and Welfare.** Report on National Health and Nutritional Examination, 2008: Ministry of Health and Welfare; 2009

22 **Wei EK**, Wolin KY, Colditz GA. Time course of risk factors in cancer etiology and progression. *J Clin Oncol* 2010; **28**: 4052-4057 [PMID: 20644083 DOI: 10.1200/JCO.2009.26.9324.]

23 **Saito H**. Colorectal cancer screening using immunochemical faecal occult blood testing in Japan. *J Med Screen* 2006; **13** Suppl 1: S6-S7 [PMID: 17227634]

24 **Choi KS**, Lee HY, Jun JK, Shin A, Park EC. Adherence to follow-up after a positive fecal occult blood test in an organized colorectal cancer screening program in Korea, 2004-2008. *J Gastroenterol Hepatol* 2012; **27**: 1070-1077 [PMID: 22004224 DOI: 10.1111/j.1440-1746.2011.06944.x.]

25 **Lee EH**, Lee HY, Choi KS, Jun JK, Park EC, Lee JS. Trends in Cancer Screening Rates among Korean Men and Women: Results from the Korean National Cancer Screening Survey (KNCSS), 2004-2010. *Cancer Res Treat* 2011; **43**: 141-147 [PMID: 22022290 DOI: 10.4143/crt.2011.43.3.141.]

26 **Yeoh KG**, Chew L, Wang SC. Cancer screening in Singapore, with particular reference to breast, cervical and colorectal cancer screening. *J Med Screen* 2006; **13** Suppl 1: S14-S19 [PMID: 17227636]

**P-Reviewers** Mantoo SK, Trinder D **S-Editor** Gou SX

**L-Editor E-Editor**

**Figure 1 Trends in age-standardized colorectal cancer mortality rates per 100 000 in Hong Kong, Japan, Korea and Singapore, 1955-2010.** A: Men 30-49 years; B: Men 50-69 years; C: Men ≥ 70 years; D: Women 30-49 years; E: Women 50-69 years; F: Women ≥ 70 years.

****

**B.**

****

**C.**

****

**D.**

****

**E.**

****

**F.**

****

**Table 1 Colorectal cancer mortality rates in Hong Kong, Japan, Korea and Singapore, 1955-2010 (age-standardized mortality rates per 100 000)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Period** | **Men** | **Women** |
| **1955** | **1975** | **1995** | **2005** | **1955** | **1975** | **1995** | **2005** |
| Hong Kong | 1969-2009 | - | 29.7 | 40.7 | 37.8 | - | 18.8 | 26.1 | 23.4 |
| Japan | 1955-2009 | 14.5 | 23.8 | 38.2 | 34.8 | 12.5 | 18.3 | 22.3 | 20.8 |
| Korea | 1985-2010 | - | - | 8.6 | 30.5 | - | - | 11.8 | 17.2 |
| Singapore | 1966-2009 | - | 37.2 | 52.1 | 36.8 |  | 26.1 | 31.7 | 27.5 |

**Table 2 Joinpoint analysis for colorectal cancer mortality at all ages and at age 30-49, 50-69, and 70+, in Hong Kong, Japan, Korea and Singapore, 1955-2010**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Trend 1** | **Trend 2** | **Trend 3** | **Trend 4** |
|  | **Year** | **APC** | **Year** | **APC** | **Year** | **APC** | **Year** | **APC** |
| Men |  |  |  |  |  |  |  |  |
| All ages |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-1995 | 1.31 | 1995-2009 | -0.1 |  |  |  |  |
| Japan | 1955-1975 | 2.01 | 1975-1992 | 1.21 | 1992-2004 | -0.41 | 2004-2009 | -2.21 |
| Korea | 1985-2002 | 7.91 | 2002-2010 | 0.3 |  |  |  |  |
| Singapore | 1966-1995 | 1.41 | 1995-2009 | -1.51 |  |  |  |  |
| 30-49 years |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-2009 | -1.11 |  |  |  |  |  |  |
| Japan | 1955-1960 | -1.0 | 1960-1977 | 3.81 | 1977-1998 | -0.51 | 1998-2009 | -2.51 |
| Korea | 1985-2002 | 2.51 | 2002-2010 | -2.1 |  |  |  |  |
| Singapore | 1966-1989 | 0.5 | 1989-2009 | -2.61 |  |  |  |  |
| 50-69 years |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-1994 | 1.21 | 1994-2009 | -0.4 |  |  |  |  |
| Japan | 1955-1963 | 0.4 | 1963-1995 | 2.91 | 1995-2009 | -1.61 |  |  |
| Korea | 1985-2003 | 6.51 | 2003-2010 | -1.41 |  |  |  |  |
| Singapore | 1966-1989 | 2.11 | 1989-2009 | -1.21 |  |  |  |  |
| ≥ 70 years |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-2001 | 1.91 | 2001-2009 | -0.8 |  |  |  |  |
| Japan | 1955-1980 | 3.41 | 1980-1998 | 2.01 | 1998-2009 | -0.91 |  |  |
| Korea | 1985-1994 | 14.01 | 1994-1998 | 5.9 | 1998-2002 | 12.21 | 2002-2010 | 1.11 |
| Singapore | 1966-1995 | 1.71 | 1995-2009 | -0.9 |  |  |  |  |
| Women |  |  |  |  |  |  |  |  |
| All ages |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-1996 | 1.51 | 1996-2009 | -1.71 |  |  |  |  |
| Japan | 1955-1960 | 14.31 | 1960-1983 | 2.91 | 1983-1996 | 0.91 | 1996-2009 | -0.71 |
| Korea | 1985-1994 | 9.91 | 1994-2004 | 4.31 | 2004-2010 | -1.21 |  |  |
| Singapore | 1966-1980 | 4.71 | 1980-1998 | -0.2 | 1998-2009 | -2.61 |  |  |
| 30-49 years |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-1992 | 0.4 | 1992-2009 | -2.41 |  |  |  |  |
| Japan | 1955-1963 | 0.2 | 1963-1974 | 3.11 | 1974-1991 | 0.3 | 1991-2009 | -2.11 |
| Korea | 1985-1991 | 8.81 | 1991-2010 | -0.6 |  |  |  |  |
| Singapore | 1966-1984 | 2.8 | 1984-2009 | -3.21 |  |  |  |  |
| 50-69 years |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-1994 | 1.01 | 1994-2009 | -2.31 |  |  |  |  |
| Japan | 1955-1963 | 0.4 | 1963-1992 | 1.41 | 1992-2004 | -0.81 | 2004-2009 | -2.51 |
| Korea | 1985-1994 | 8.31 | 1994-2003 | 3.31 | 2003-2010 | -1.1 |  |  |
| Singapore | 1966-1980 | 4.41 | 1980-2009 | -1.81 |  |  |  |  |
| 70+ years |  |  |  |  |  |  |  |  |
| Hong Kong | 1969-2002 | 2.51 | 2002-2009 | -1.91 |  |  |  |  |
| Japan | 1955-1975 | 3.11 | 1975-1999 | 1.11 | 1999-2009 | -0.91 |  |  |
| Korea | 1985-1993 | 16.91 | 1993-2003 | 7.71 | 2003-2010 | 0.0 |  |  |
| Singapore | 1966-1981 | 5.81 | 1981-2000 | 0.91 | 2000-2009 | -2.61 |  |  |

1*P* < 0.05 *vs* the younger age groups. APC: Annual percent change.