RESEARCH COMMUNICATION

Pattern and Time Trends of Stomach Cancer in Asia from 1950-99

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Abstract

Background: **As there is a lack of data on stomach cancer disease in Asia, the aim of the present study was to examine patterns and time trends for this neoplasm in Asian countries.**

Methods: **A descriptive study was designed to examine the cancer pattern and time trend and to calculate the annual change in mortality and incidence of stomach cancer at 5-year intervals. Data were derived from the WHO Mortality Database, and Cancer Incidence in Five Continents.**

Results: **The highest rates of stomach cancer mortality and incidence (ASR) were observed in Japan, followed by the Republic of Korea, and China, the lowest rates being observed in Thailand. The highest to lowest ratios were 50 and 32 for mortality and 120 and 45 for incidence in males and females, respectively. A decreased trend of mortality was found in all 16 countries where mortality data was available, however, before the decrease, an increased trend was found in Japan in the 1950s and in Sri-Lanka in the 1950-60s. In spite of a significant decrease in mortality nationwide in Japan, an increased trend of stomach cancer incidence was found in Hiroshima (ASR + 7.4 in males and + 1.5 in females for each 5-year period).**

Discussion: **There are very large geographical differences in risk factors of stomach cancer from country to country, and these risk factors are still highly prevalent in specific areas of Asia. Further ecological study with emphasis on host and environmental factors for stomach cancer in Asian countries are strongly recommended.**

Key Words: Stomach cancer - time trend - pattern - mortality - incidence - Asia

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Background

Among cancer occurrence throughout the world, about 10% of all new cases and 12% of all deaths is due to stomach cancer, (Parkin et al., 1999; Pisani et al., 1999), this neoplasm being the second most frequent cause of death in both sexes, (Murray & Lopez, 1997; Pisani et al., 1999). In North America and European countries, a significant decline in stomach cancer has been observed due to a decrease in exposure to risk factors, (Ayiomamitis, 1988; Coleman et al., 1993; Devesa et al., 1987; Dockerty et al., 1991; Hansson et al., 1991; Laheij et al., 1999; Swerdlow et al., 1998; Valerianova et al., 1994). Per each 5-year period from 1973-88, for all ages of both sexes, stomach cancer incidence and mortality decreased by about 10-30% in Europe, America (North, Central, and South), and Oceania, (Coleman et al., 1993). Despite this significant decrease in these three areas this disease is still a big problem worldwide. At present, no essential risk factor for stomach cancer has been confirmed, but at least in part, environmental and occupational risk factors might be related to this disease, (Boland & Scheiman, 1991; Clark et al., 1983; Davis, 1989; Nomura, 1996). Environmental and occupational risk factors have been " exported" from developed countries to developing countries globally and to Asian countries in particular where economic activities are being significantly developed, (Vineis et al., 1995). Therefore, studies on stomach cancer in developing countries and especially in Asia should be very helpful in controlling this disease in the future. Asia is covers the largest area throughout the world, where 57% of all deaths from all

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causes and 43% of cancers for all sites occurred in 1980, (Hakulinen et al., 1986). However, data of stomach cancer is still lacking in Asia, as far as we know. Therefore, because a study on this disease is timely and urgent, the aim of the present study was to examine the pattern and time trend of stomach cancer in Asian countries.

Materials and Methods

A descriptive study on the distribution or the pattern and time trend of stomach cancer was used for the present study. The unit for mortality study was country level and for incidence it was population level according to population-based cancer registries of Asian countries. For comparison, standardized incidence and mortality (world population, ASR per 100,000 or ASR) of stomach cancer from each country or from each population was used. During the time period from 1950-99, the trend of stomach cancer mortality and incidence was calculated using Microsoft Excel in PC. A figure for the mortality or incidence (ASR) and the time (year) was developed by adding a trend line with display equation (Y = a * X + b) and R2 on a chart, where "Y" was mortality or incidence, "a" was a parameter for "X", and "b" was an intercept. The "a" value in this result shows the change of incidence or mortality rate (ASR) per unit of the time period. The unit of time period for mortality was a one-year interval and for incidence it was a five-year interval. For data of incidence, we decided to examine the time trend for a data set with at least 3 five-year periods obtained from population-based cancer registries of Asian countries. For data of mortality, we examined the time trend when the mortality curve was seen to be steadily increasing or decreasing with a clear peak value.

World population and stomach cancer mortality and incidence in 2000 was derived from the World Population Prospects, the 2000 Revision Highlights and from GLOBOCAN, (IARC, 2001; United Nations, 2001). For the period from 1950-99, stomach cancer mortality was deduced from Mortality Database and from World Health Statistics Annual, (WHO, 1983; WHO, 1988; WHO, 1990; WHO, 1993; WHO, 1994; WHO, 1996; WHO, 2001a; WHO, 2001b). Incidence data was taken from Cancer Incidence in Five Continents from Vol. III-VII because data of most of the Asian Population-Based Cancer Registries are available from Vol. III, (Muir et al., 1987; Parkin et al., 1992; Parkin et al., 1997; Segi et al., 1981; Waterhouse et al., 1976; Waterhouse et al., 1982). We decided to use the point time in 1970, 1974, 1979, 1984, and 1989 for incidence data from Vol. III, IV, V, VI, and VII, respectively.

Results

Data Quality

In 2000, the population was available for 187 countries and stomach cancer data was linked to 173 countries. The remaining 14 countries had no available data of stomach cancer and the population numbered at 3.8 million males and 3.7 million females. We decided to calculate the proportion of population and stomach cancer among the 173 available countries. Among these countries, 46 countries are in Asia and comprise 61.5% males and 59.8% females of the world population. Among the 46 Asian countries, data of deaths from all causes and from stomach cancer was available for 19 countries from 1980-1995; data of annual stomach cancer mortality was available for 16 countries from 1950-99. The data of stomach cancer incidence was available for 16 populations (4 in Japan, 2 in China, 3 in Singapore, 1 in Hong Kong, 1 in India, and 5 in Israel) from 1970-89. For stomach cancer mortality, data is available from 1951-76 (Israel, Jewish), 1975-87 and 1993-97 (Kuwait), 1981-82 and 1985-97 (Armenia and Kazakhstan), 1981-82 and 1985-99 (Azerbaijan and Kurgyzstan), 1981-82, 1985-92, and 1994-95 (Tajikistan), 1981-82 and 1985-95 (Uzbekistan), 1981-82, 1985-94, 1996-98 (Turmenistan), 1988-98 (China), 1959-96 (Hong Kong), 1950-97 (Japan), 1950-67, 1976, 1979-86 (Sri-Lanka), 1957-78, 1980-87, 1994 (Thailand), 1985-97 (R. of Korea), and 1963-98 (Singapore).

Stomach cancer pattern in Asia

In Asia, for males, the proportion of stomach cancer mortality and incidence was higher when compared to the proportion of population (63.8% and 66.7% VS. 61.5%, respectively). For females, the proportion of stomach cancer mortality was lower and a fairly higher incidence when compared to the proportion of population (57.1% and 60.3% VS. 59.8%, respectively), (Fig. 1).

Pattern of Stomach Cancer Mortality

The proportion of deaths from stomach cancer among deaths from all causes was highest in Japan in both males and females (6.5% and 4.5%) followed by the Republic of Korea (5.6%, 4.3%), China (4.2%, 2.8% and 4.0%, 2.5% in rural and urban areas, respectively). The lowest proportion of deaths from stomach cancer was found in Thailand, 0.1% in males and 0.1% in females among deaths from all causes,

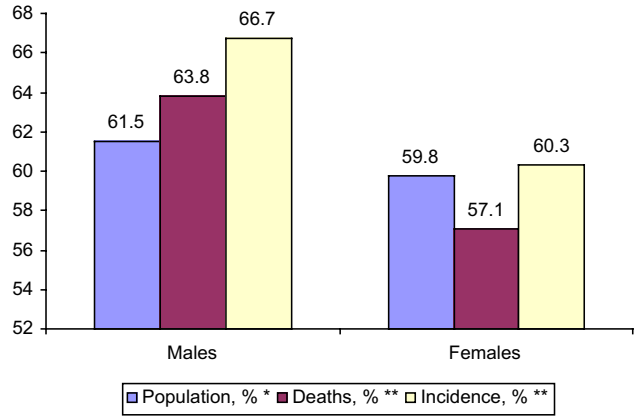

Figure 1. Proportion (%) of Asia Population, Incidence, Deaths from Stomach Cancer in Males and Females in 2000

(Fig. 2). The proportion of deaths from stomach cancer was 50 and 32 times higher in males and females, respectively, in Japan when compared to those in Thailand.

Pattern of Stomach Cancer Incidence

For pattern of stomach cancer incidence in 31 populations selected in Asia, the highest incidence rate was seen in Japan, Yamagata, (ASR 95.5 and 40.1 in males and females, respectively). The lowest incidence rate was seen in India, Bashi, Paranda and Bhum, (ASR 0.8 and 0.9 in males and females respectively), (Fig. 3). The ratios between highest and lowest incidence rate were 120 in males and 45 in females. The ten most common stomach cancer incidences were seen in 6 populations in Japan, one in Korea, and 3 in China. A fairly high stomach cancer incidence was seen in Singapore – Chinese, (ASR 29.3 and 13.6 in males and females, respectively), Viet Nam, Hanoi (ASR 20.9 and 10.4 in males and females, respectively).

Trend of stomach cancer in Asia

The most striking new finding in the present study was the natural picture of stomach cancer mortality by time for the 50-year period from 1950-99 and incidence for the 20-year period from 1970-89 for 16 countries and 16 populations in Asia. Among 16 curves for both mortality and incidence, we could see both the increase and decrease periods in mortality and incidence of stomach cancer or onset of risk factors and retreat of this disease. That is, in Sri-Lanka, stomach cancer mortality (ASR) was about 2.4 in males and 2.6 in females (1950), then reached a peak at 7.1 in males and 11.2 in females (1968), and decreased to 3.8 in males and 5.1 in females (1986), (Fig. 4). In Japan, stomach cancer mortality (ASR) in 1950 was observed at 64.9 and 35.6 in males and females, respectively, reached a peak at 71.3 in males (1958) and 37.8 in females (1956), then diminished to 29.2 in males (1997) and 11.7 in females (1997).

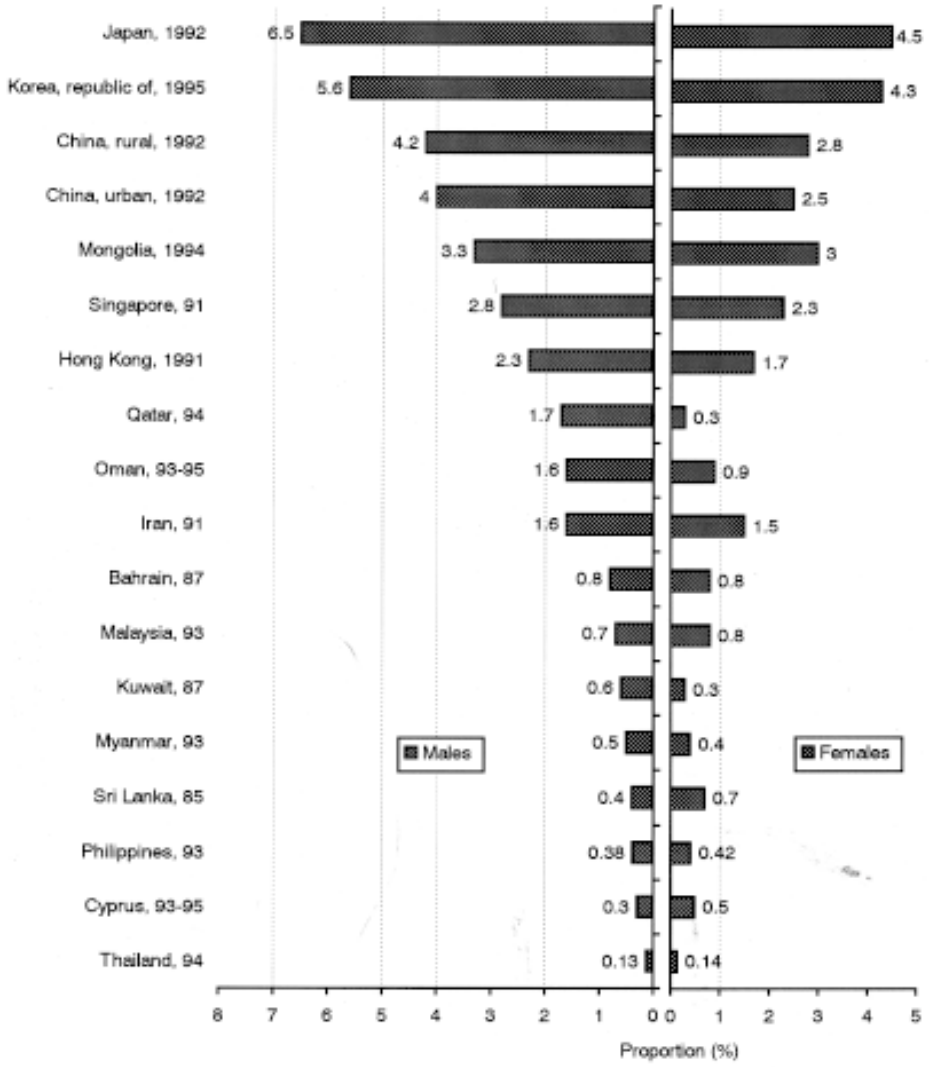

Figure 2. Proportion (%) of Deaths from Stomach Cancer in Males and Females in Selected Asian Countries

Stomach Cancer Mortality

An increased trend was seen in Japan before 1958 for males and 1956 for females and in Sri-Lanka before 1968 for males and 1966 for females. Since 1950 a decreased trend was seen in all the other 14 countries where stomach cancer mortality data is available. For the increased period, the annual increased mortality (ASR) was +0.74 and +0.33 in males (1950-58) and females (1950-56) respectively in Japan and +0.41 in males (1950-68) and +0.23 in females (1950-66) in Sri-Lanka. The correlation between mortality rate and the time (year) was very strong with R2 ranked from 0.81 to 0.96. For the decreased period, the fastest decrease in annual stomach cancer mortality (ASR) was found in Japan (–1.25 and –0.73 in males and females, respectively), followed by the Republic of Korea (-1.07 and –0.61 in males and females, respectively). A decrease in stomach cancer mortality was also seen in Thailand (-0.01) in both males and females where the lowest stomach cancer mortality from 1957-94 was seen among 16 available mortality data sets, (Fig. 4). A constant decrease in annual stomach cancer mortality in both males and females was found in China, Hong Kong, Sri-Lanka, Israel – Jewish. Azerbaijan, Kazakhstan, and Uzbekistan with R2 ranked from 0.71 to 0.93, (Table 1).

Stomach Cancer Incidence

Among 16 populations in Asia, a decreased trend was seen in 15, and an increased trend was seen in one - Hiroshima in both males and females. Among 15-decreased trends, the constant 5-year decrease (ASR) was seen, in males and females, respectively, in Nagasaki (-9.06, -6.35), Osaka (-5.72, -4.14), Tianjin (-3.30, -1.80), Singapore - Chinese (-3.90, -1.08), Bombay (-0.56, -0.56), Israel: all Jews (-2.04, -1.87) with R2 ranked from 0.73 to 0.99. There was

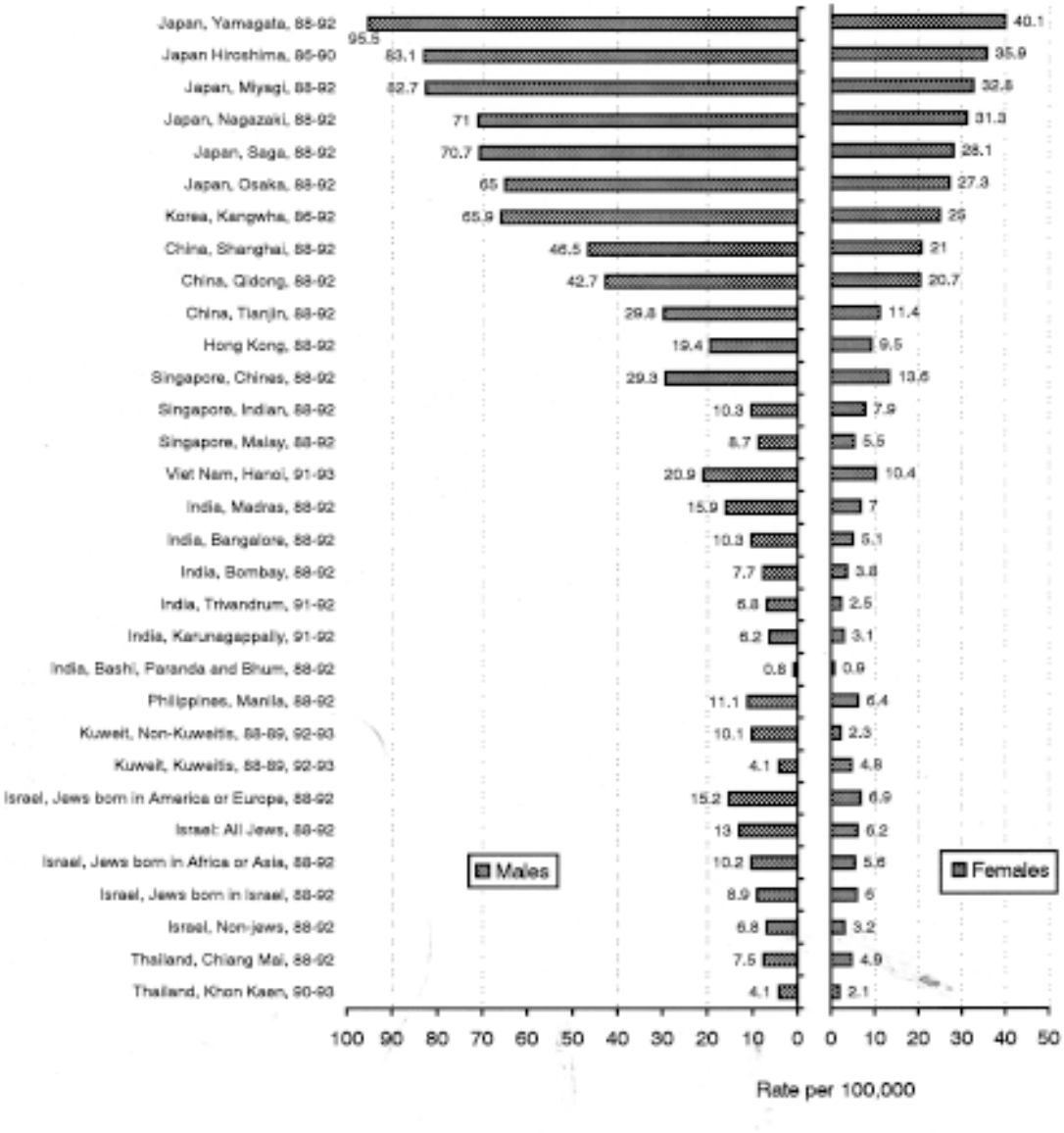

Figure 3. Stomach Cancer Incidence (ASR-W) in Selected Male and Female Populations in Asia

Table 1. Trend of Stomach Cancer Mortality (ASR-W) for the Increased and Decreased Period. Mortality to Incidence Ratios in Selected Asian Countries for Males and Females

Country	Mortality to incidence ratios*		Cancer mortality (ASR-W) changes per 1-year period, R2					
			Increased period			Decreased period		
	Males	Females	Time period	Males	Females	Time period	Males	Females
Japan	0.47	0.51	1950-58	+0.74, 0.96	-	1958-97	-1.25, 0.98	-
			1950-56	-	+0.33, 0.91	1956-97	-	-0.73, 0.98
Korea, Republic of	0.60	0.70	-	-	-	1985-97	-1.07, 0.76	-0.61, 0.83
China	0.74	0.75	-	-	-	1988-98	-0.94, 0.87	-0.47, 0.90
Singapore	0.78	0.79	-	-	-	1963-98	-0.71, 0.87	-0.27, 0.64
Hong Kong	0.59	0.59	-	-	-	1-60-96	-0.32, 0.85	-0.20, 0.84
Sri-Lanka	0.84	0.84	1950-68	+0.41, 0.81	-	1968-86	-0.28, 0.90	-
			1950-66	-	+0.23, 0.91	1966-86	-	-0.20, 0.89
Thailand	0.86	0.86	-	-	-	1957-94	-0.01, 0.13	-0.01, 0.04
Israel, Jewish	0.62	0.81	-	-	-	1951-76	-0.49, 0.71	-0.48, 0.91
Kuwait	0.85	0.77	-	-	-	1975-97	-0.18, 0.35	-0.16, 0.34
Armenia	0.72	0.74	-	-	-	1981-97	-0.51, 0.66	-0.22, 0.41
Azerbaijan	0.72	0.74	-	-	-	1981-99	-0.87, 0.86	-0.37, 0.89
Kazakhstan	0.73	0.75	-	-	-	1981-97	-0.89, 0.93	-0.40, 0.91
Kurgyzstan	0.73	0.74	-	-	-	1981-99	-0.80, 0.87	-0.22, 0.60
Tajikistan	0.73	0.75	-	-	-	1981-95	-0.83, 0.46	-0.21, 0.23
Turkmenistan	0.72	0.76	-	-	-	1981-99	-0.97, 0.83	-0.49, 0.68
Uzbekistan	0.72	0.74	-	-	-	1981-95	-0.74, 0.82	-0.36, 0.86

* Age standardized mortality to incidence rate ratios, world population. Source of data (IARC, 2001)

a very weak decreased trend of stomach cancer incidence among males in Miyagi (-0.64 per 5-year), and in females in Hong Kong (-0.08 per 5-year) with R2 ranked from 0.1 and 0.02, respectively. In Hiroshima, the 5-year increase incidence (ASR) was + 7.4 in males (R2 = 0.69) and + 1.5 in females (R2 = 0.46) from 1974-89, (Table 2).

Table 2. Trend of Stomach Cancer Incidence (ASR-W) in Selected Male and Female Populations in Asia

Population	Cancer incidence (ASR-W) changes per 5-year period, R2		
	Time period	Males	Females
Nagazaki	1974-89	-9.06, 0.90	-6.35, 0.79
Hiroshima	1979-89	+7.4, 0.69	+1.5, 0.46
Osaka	1970-89	-5.72, 0.90	-4.14, 0.98
Miyagi	1970-89	-0.64, 0.10	-1.99, 0.76
Shanghai	1975-89	-3.42, 0.74	-0.27, 0.04
Tianjin	1981-89	-3.30, 0.99	-1.80, 0.94
Singapore: Chinese	1970-89	-3.90, 0.96	-1.08, 0.91
Singapore: Indian	1970-89	-3.37, 0.89	-2.85, 0.52
Singapore: Malay	1970-89	-0.49, 0.28	-1.02, 0.86
Hong Kong	1974-89	-0.64, 0.23	-0.08, 0.02
Bombay	1970-89	-0.56, 0.73	-0.56, 0.74
Jews born in Africa or Asia	1970-89	-1.34, 0.95	-1.63, 0.84
Jews born in Europe or America	1970-89	-1.68, 0.99	-1.91, 0.97
Jews born in Israel	1970-89	-2.04, 0.95	-0.51, 0.86
All Jews	1970-89	-2.04, 0.99	-1.87, 0.99
Non-Jews	1970-89	-0.53, 0.66	-0.48, 0.30

Discussion

Data quality among Asian countries was very important to examine stomach cancer patterns in the present study. There were large differences in quality of disease diagnosis between Japan and Thailand in 1978, that is, the proportion of causes of deaths as "symptoms and ill-defined conditions" in Thailand was 47% but it was only 5% in Japan, (WHO, 1980). However, in the 1990s, population-based cancer registries in selected Asian countries have shown that stomach cancer incidences are very much different from country to country, (Fig. 3). The mortality pattern has been consistent with the incidence pattern among populations in Asia with available mortality and incidence data, (Fig. 2 and Fig. 3). These facts indicated that, the pattern and time trend of stomach cancer mortality and incidence could reflect the real problem in Asia.

Stomach cancer mortality in Japan has been rapidly decreasing in both males and females since 1958. The lowest ratio of mortality to incidence was seen in Japan (0.47 in males and 0.51 in females) when compared to that in other countries, (Table 1). This reduction in stomach cancer deaths was partly due to successful medical care and screening for stomach cancer in Japan, (Tominaga, 1987; Tominaga, 1992). Medical care reduced stomach cancer deaths by about 17.9% in males and 11.0% in females in Miyagi from 1970-80, (Shimizu & Hisamichi, 1988). However, from 1970-80 nationwide in Japan, stomach cancer mortality decreased about 23.4% in males and 27.9% in females, which is greater than that mentioned for Miyagi, Japan, (Fig. 4). Overall, 54% of the decline in stomach cancer mortality has been due to the reduction of exposure to risk factors, (Sasaki &

Akai, 1985). There has been a decrease in exposure to risk factors of stomach cancer in Japan at the national level. In spite of the significant decrease in stomach cancer deaths, stomach cancer incidence in Japan was seen to be highest not only in Asia but throughout the world, (Parkin et al., 1997). The increased trend of stomach cancer incidence in Hiroshima, Japan was observed during the time of the present study. This fact indicates that, risk factors of stomach cancer have been prevalent in Japan in particular and in Asia in general from 1950-99. In spite of the very large differences in stomach cancer mortality (ASR) among the16 countries studied, Figure 5 shows a picture of significant differences in time trends among males and females. The lowest stomach cancer mortality (Thailand) curve shows a fairly stable time trend. The curve of stomach cancer mortality in Sri-Lanka shows a time onset (1950), a peak (1968 for males, 1966 for females), and a retreat time (1986). Thereafter, in 2000 stomach cancer mortality in Sri-Lanka was much diminished, only 1.0 and 0.5 (ASR) in males and females, respectively, (IARC, 2001). Among the other 14 curves, there are various changes in stomach cancer mortality.

The marked differences and a substantial decline in the incidence and mortality of stomach cancer worldwide have been well documented, (Muir, 1987). The present study confirmed a similar observation among Asian countries. The large regional differences in the incidence of stomach cancer suggest environmental influences in developing this disease in humans. Differences in diet, such as salt intake, vegetables, fruit, and animal protein consumption, lifestyle (smoke, alcohol and coffee drinking), and also cooking methods, may explain the large differences in incidence of stomach cancer from country to country in Asia. In spite of the limitation of

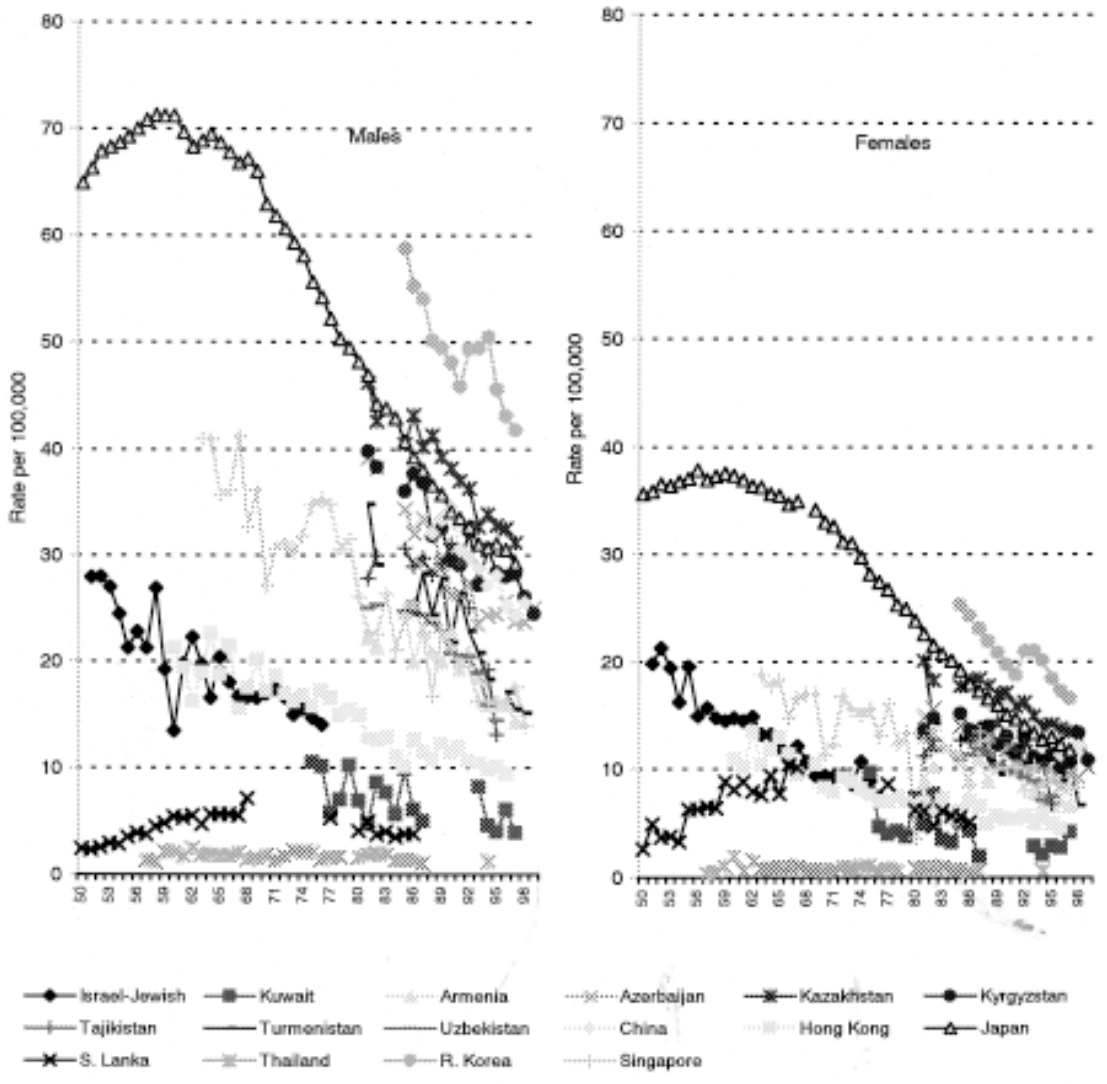

Figure 4. Trend of Stomach Cancer Mortality (ASR-W) in Selected Asian Countries for Males and Females

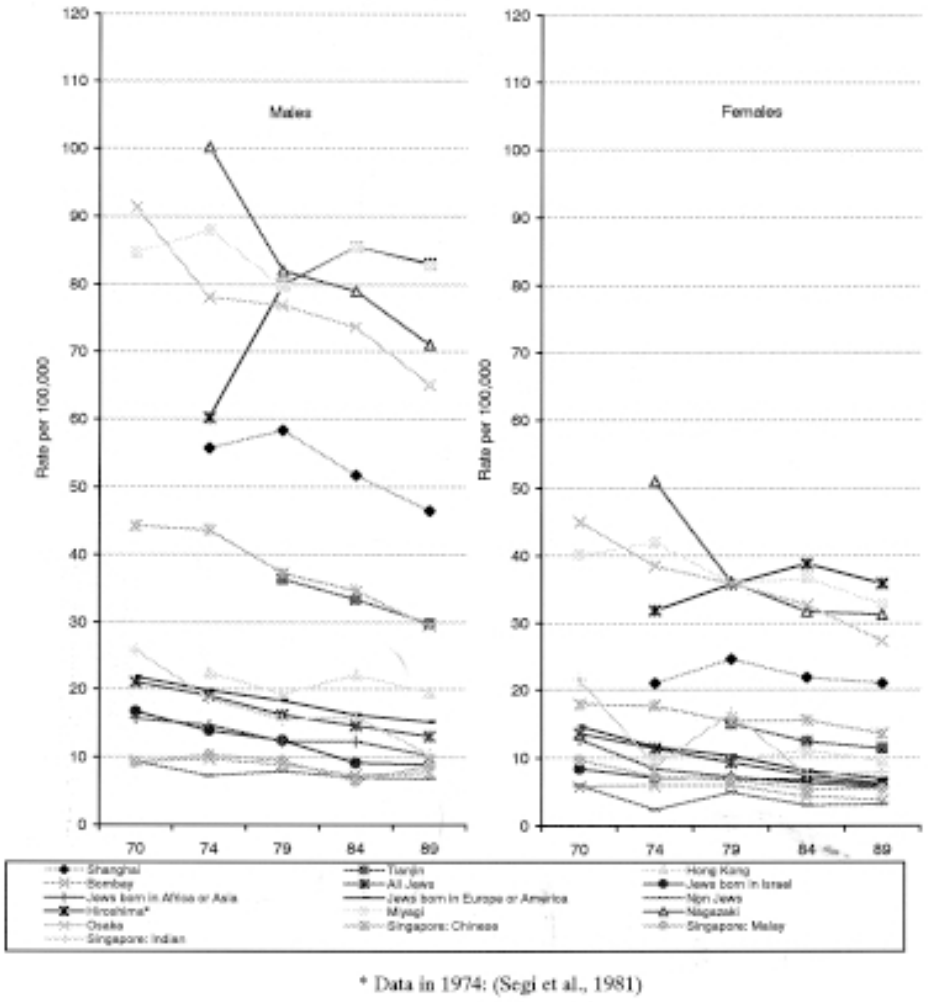

Figure 5. Trend of Stomach Cancer Incidence (ASR-W) in Selected Male and Female Populations in Asia from 1970-89

data source and accuracy, the present results have suggested that, there are very large geographical differences in risk factors of stomach cancer from country to country in Asia and the risk factors of stomach cancer are still highly prevalent. Further international studies on ecology, host and environmental factors for stomach cancer are strongly recommended among Asian countries.

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