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Impact of economic crisis on cause-specific mortality in South Korea

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Background Economic changes can be powerful determinants of health. In the late 1990s, South Korea experienced a steep economic decline. This study examines whether the massive economic changes affected trends in all-cause and cause-specific mortality in South Korea.

Method Mid-year population estimates of 5 year age groups (denominators) and death certificate data (numerators) from the National Statistical Office of Korea were used to compute cause-specific age-standardized mortality rates before and after the economic crisis.

Results All-cause mortality continued to decrease in both sexes and all age groups during the crisis. Cerebrovascular accidents, stomach cancer, and liver disease contributed most to this decline. A remarkable decrease in transport accident mortality rates was also observed. The most salient increase in mortality was suicidal death. Mortality from homicide, pneumonia, and alcohol dependence increased during the economic crisis, but these accounted for a small proportion of total mortality.

Conclusions Short-term mortality effects of the South Korean economic crisis were relatively small. It appears that any short-term effects of the economic decline were overwhelmed by the momentum of large declines in causes of death such as stroke, stomach cancer, and liver disease, which are probably related to exposures with much longer aetiological periods. However, this study focused on rather immediate mortality effects and follow-up studies are needed to elucidate any longer-term health effects of the South Korean economic crisis.

Keywords Economic recession, socioeconomic factors, mortality, South Korea

Introduction

After enjoying uninterrupted economic growth for decades, South Korea underwent a steep economic decline in the late 1990s. On November 21, 1997, the South Korean government made an official request to the International Monetary Fund for an emergency rescue loan. Even though the economic crisis was strictly financial and resulted from excessive foreign and domestic borrowing by firms and financial institutions, the crisis led to broad structural re-adjustments for South Korea. This caused an abrupt reversal of the accelerating economic growth of previous decades. South Korea's annual GDP growth rate of 5–10% reversed to −6.7% in 1998.[1] The unemployment rate of 2.6% in the last quarter of 1997 increased to 8.4% in the first quarter of 1999—the highest level in South Korea's recent history (Figure 1).[2] Household income reduced by 6.7% in 1998, representing the first household income reduction since data was collected in South Korea in 1963.[1] The economic crisis seemingly ended with the redemption of all rescue loans by August 2001, but nevertheless changed the South Korean economy in many aspects. For example, 'flexibility' of the labour market has increased markedly. Of the total number of wage and salary workers, the proportion of temporary and daily workers increased from 43.2% in 1996 to 51.6% in 2002.[2] Disposable income inequality soared during this period, skyrocketing from a Gini of 0.298 in 1996 to 0.358 in 2000. This put South Korea third after Mexico and the United States among OECD countries.[3]

Severe economic downturns have been shown to increase health risks and eventually affect mortality.[4,5] In the 1990s, a substantial decline in life expectancy after the collapse of the

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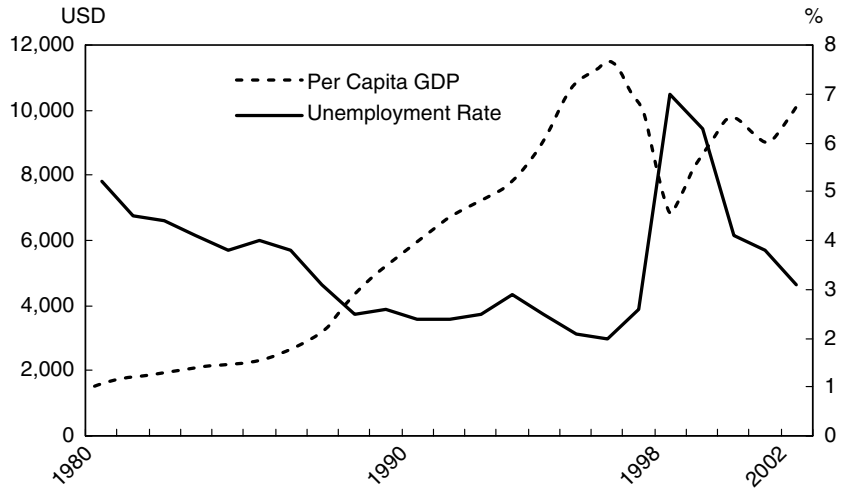

Figure 1 Annual per capita gross domestic product (GDP) and unemployment rates between 1980 and 2002 in South Korea

Soviet Union demonstrated the huge population health effects of severe economic, political, and social turmoil.[6–9] An impact of economic crises on population health may also be salient given the substantial fluctuation in economic conditions across East Asia during the past decade. There are reports that the Indonesian economic crisis in 1997 affected self-reported morbidity,[10] child nutritional status,[11] and infant mortality rates.[12] Increases in low birth weight and underweight among primary school children were noticed in Thailand during their economic crisis.[13] However, no significant changes in morbidity and mortality have been reported in the Philippines, Vietnam, or Lao PDR.[14] Few studies have focused on the impact of East Asian economic crises on mortality in part due to the paucity of data and the political climate in some countries that dissuaded epidemiological investigations. In South Korea there have been several reports on the impact of the economic crisis on suicide.[15,16] A prior study examined the impact of economic crisis on several selected causes of death[17] but the limited time span examined and validity of this analysis has been questioned.[18] Apart from these, however, there has not been a systematic analysis of the mortality effects of the South Korean economic crisis according to different age groups and gender. The purpose of this study is to evaluate the impact of the economic crisis on cause-specific mortality in South Korea. We hypothesized that, within the limited time frame used here, the effects of the economic crisis may be seen on changes in trends for causes of mortality that involved short time lags.

Methods

We computed cause-specific age-standardized mortality rates by sex before and after the economic crisis. The 2000 world standard population was used as the age reference.[19] For mortality, we obtained mid-year population estimates of 5 year age groups (denominators) and death certificate data (numerators) from the National Statistical Office (NSO) of Korea. Sex-specific and age-specific population estimates came from the population census conducted every 5 years by NSO.[20] By the late 1980s, complete death certification among persons over the age of 5 reached 100%,[21] but the data is incomplete for infant and, in particular, neonatal death[22] especially when a baby dies before the birth is reported.[22] Causes of death were coded with the 10th revision of the International Classification of Disease (ICD-10). This study categorized age into four groups: 1–14, 15–34, 35–64, and 65–79. Infant death was not included in our analysis owing to incomplete data. In addition, decedents aged 80+ were not included because (i) the proportion of ill-defined causes of death (e.g. senility) was high and (ii) the NSO did not provide 5 year specific population estimates for the group aged 80+, instead presenting age-collapsed population numbers.

Results

All-cause mortality changes in South Korea

Figure 2 shows trends in age-standardized mortality rate at different ages from 1990 to 2002. All-cause mortality rate decreased between 1990 and 2002 in all age groups and both sexes.

Cause-specific mortality changes among males and females aged 1–14 and 15–34

Table 1 presents cause-specific calendar-year mortality rate ratios for South Koreans aged 1–14 and 15–34 with the 1996 mortality rate being the referent. Most striking was the steep decline in deaths from transport accidents; a 35 and 38% decrease in the 1–14 year and 15–34 year age-groups, respectively between 1996 and 1998. This decrease in mortality accounted for 57.1% (among those aged 1–14) and 88.5% (among those aged 15–34) of the total decrease in mortality between 1996 and 1998. Increase in suicide mortality was detected among males and females aged 15–34. The most noticeable relative rise was found in homicide death among those aged 1–14, although the rates in this age group are very low. Age-adjusted homicide mortality increased 84% in 1998, and then slightly decreased in 2000 and 2002. Results varied with sex in the 15–34 age group (data not shown here). An increase of 14% in homicide mortality was found among females, whereas no such increase was detected among males. In 1998, deaths from

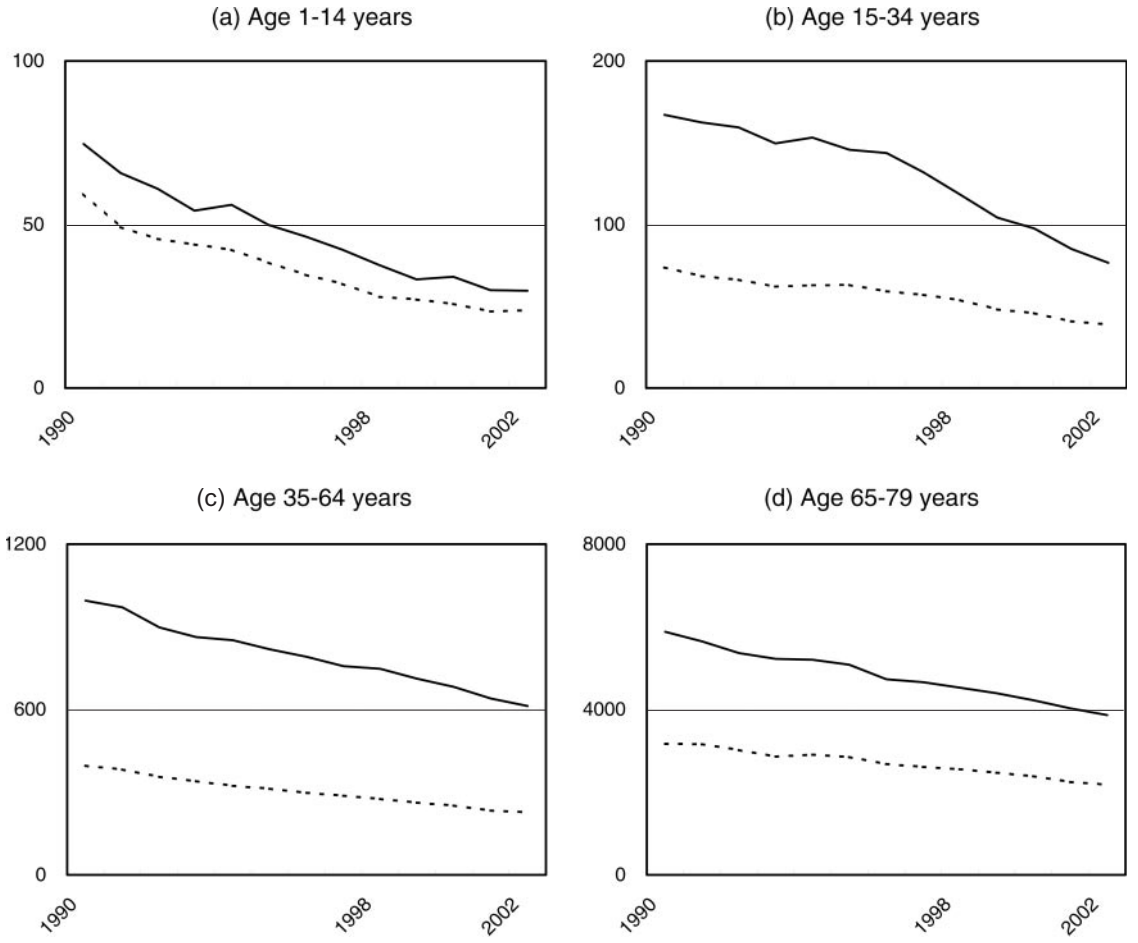

Figure 2 Trends in age-standardized mortality rates per 100 000 at (a) 1–14 years (b) 15–34 years (c) 35–64 years (d) 65–79 years different ages in South Korea, 1990–2002. Solid lines are for males and dotted lines are for females

respiratory diseases showed 27% (in males aged 15–34) and 8% (in females aged 15–34) increase compared with mortality rates in 1996.

Cause-specific mortality changes among males and females aged 35–64

Among both sexes aged 35–64, a stepwise decrease in the mortality rate ratios between 1996 and 2002 was found in causes of death such as stomach cancer, cerebrovascular accidents, liver disease, tuberculosis, and cardiomyopathy and conduction disorders (Table 2). Mortality from stomach cancer, cerebrovascular accidents, and liver disease accounted for ~30% of all deaths in 1996 and ~26% in 2002. Another stepwise decrease was found for hypertensive disease, transport accidents, and exposure to fire (in males) and accidental poisoning (in females). Transport accident mortality rates showed a great decline in 1998 (31% in males and 35% in females) and further decreased through 2002. As a result, age-adjusted mortality rates from transport accidents in 2002 were less than half of the 1996 level among both sexes. Meanwhile, we found graded increases in age-standardized mortality rates in colorectal cancer and ischaemic heart disease between 1996 and 2002 among both sexes. In addition, fluctuating mortality patterns were detected during the economic crisis in pneumonia, accidental drowning, suicide, and homicide. Suicide mortality rates increased in 1998 (68% increase in males, 34% increase in females), returned to the 1996 level in 2000, and resurged in 2002. These patterns were the same among both sexes aged 35–64. Similar to the suicide mortality rate, deaths due to accidental drowning in both sexes increased in 1998 and returned to the 1996 level in 2000. However, the rate did not increase in 2002. For pneumonia, the rate ratios in 1998 and 2000 showed ~40–70% increase but decreased to approximately three-fourth of the 1996 level in 2002. Homicide mortality rates showed a 14% increase among males and a 30% increase among females in 1998 but decreased in 2000 and 2002. Despite the 35–40% increase in 1998 and 2000 among females aged 35–64, mortality rates from mental and behavioural disorders due to use of alcohol (alcohol dependence) remained very low.

Cause-specific mortality changes among males and females aged 65–79

As shown in table 3, trends in cause-specific calendar-year mortality rate ratios among those aged 65–79 were generally

Table 1 Cause-specific age-standardized (to 2000 world population) mortality rates per 100 000 and calendar-year mortality rate ratios among South Korean males and females aged 1–14 and 15–34, 1996–2000

	Males and females aged 1–14							**Males and females aged 15–34**						
	Mortality rate (per 100 000)				Rate ratios			Mortality rate (per 100 000)				Rate ratios		
Cause of death	1996	1998	2000	2002	1998/1996	2000/1996	2002/1996	1996	1998	2000	2002	1998/1996	2000/1996	2002/1996
All causes	40.6	32.9	30.0	26.8	0.81	0.74	0.66	102.3	86.7	72.2	58.1	0.85	0.71	0.57
Infectious and parasitic diseases (A00–B99)	0.7	0.9	0.8	0.7	1.20	1.11	0.93	2.2	2.1	1.6	1.4	0.96	0.71	0.61
All cancers (C00–C97)	4.0	3.4	3.7	3.6	0.84	0.93	0.88	10.0	9.1	9.1	8.6	0.91	0.91	0.86
Endocrine, nutritional and metabolic diseases (E00–E90)	0.3	0.2	0.3	0.2	0.82	0.99	0.75	0.9	0.9	0.8	1.0	1.02	0.90	1.07
Mental and behavioural disorder (F01–F99)	0.1	0.1	0.1	0.0	0.95	0.72	0.28	1.4	1	0.9	0.5	0.70	0.63	0.37
Diseases of circulatory system (I00–I99)	1.9	1.8	1.4	1.0	0.94	0.70	0.54	7.0	6.8	5.5	4.9	0.98	0.79	0.70
Diseases of respiratory system (J00–J99)	1.6	1.5	1.6	1.3	0.96	1.01	0.80	1.1	1.3	1.2	0.9	1.19	1.03	0.81
Diseases of digestive system (K00–K93)	0.5	0.4	0.4	0.3	0.80	0.67	0.49	3.2	2.3	2.2	1.7	0.73	0.69	0.52
All external causes (V01–Y98)	22.7	17.3	15.1	13.1	0.76	0.67	0.58	67.6	54.5	43.1	33.2	0.81	0.64	0.49
Transport accidents (V01–V98)	12.6	8.2	7.5	6.3	0.65	0.60	0.50	35.8	22.0	20.2	13.2	0.62	0.57	0.37
Falls (W00–W19)	1.6	1.1	1.6	1.5	0.73	1.01	0.93	2.6	2.0	2.2	1.2	0.78	0.84	0.44
Accidental drowning (W65–W74)	4.2	3.4	3.2	2.1	0.80	0.77	0.49	4.4	3.8	3.1	1.4	0.86	0.71	0.31
Exposure to fire (X00–X09)	0.8	0.6	0.4	0.5	0.78	0.49	0.66	1.4	1.0	0.8	0.6	0.67	0.59	0.41
Accidental poisoning (X40–X49)	0.4	0.2	0.1	0.1	0.53	0.27	0.12	1.7	1.3	0.4	0.2	0.76	0.21	0.14
Suicide (X60–X84)	0.8	0.8	0.3	0.3	1.07	0.44	0.44	13.5	16.5	10.7	12.0	1.23	0.79	0.89
Homicide (X85–Y09)	0.5	1.0	0.7	0.9	1.84	1.39	1.66	2.2	1.9	1.4	1.4	0.87	0.63	0.62
Other causes	8.7	7.2	6.6	6.7	0.82	0.75	0.77	8.8	8.5	7.8	5.9	0.96	0.88	0.67

Table 2 Cause-specific age-standardized (to 2000 world population) mortality rates per 100 000 and calendar-year mortality rate ratios among South Korean males and females aged 35–64, 1996–2000

	Males aged 35–64							Females aged 35–64						
	Mortality rate (per 100 000)				Rate ratios			Mortality rate (per 100 000)				Rate ratios		
Cause of death	1996	1998	2000	2002	1998/1996	2000/1996	2002/1996	1996	1998	2000	2002	1998/1996	2000/1996	2002/1996
All causes	791.2	747.7	682.9	612.3	0.95	0.86	0.77	297.4	275.5	251.3	226.8	0.93	0.85	0.76
Infectious and parasitic diseases (A00–B99)	23.0	26.1	21.0	18.4	1.14	0.91	0.80	5.9	6.9	5.6	5.2	1.16	0.95	0.88
Tuberculosis (A15–A19)	17.7	16.1	12.7	11.0	0.91	0.72	0.62	3.8	3.1	2.7	2.1	0.82	0.71	0.56
All cancers (C00–C97)	233.8	207.2	209.7	197.5	0.89	0.90	0.84	102.3	95.1	92.3	90.9	0.93	0.90	0.89
Stomach cancer (C16)	49.8	42.9	41.1	35.4	0.86	0.83	0.71	21.6	18.3	16.0	14.8	0.85	0.74	0.69
Colorectal cancer (C18–C21)	9.5	9.9	11.7	12.7	1.04	1.22	1.33	6.9	7.3	7.8	7.9	1.07	1.13	1.16
Liver cancer (C22)	72.1	60.2	61.5	61.2	0.83	0.85	0.85	14.5	12.9	12.3	12.7	0.89	0.85	0.88
Lung cancer (C34)	41.3	39.2	39.3	35.2	0.95	0.95	0.85	10.3	10.4	10.7	9.9	1.01	1.04	0.97
Breast cancer (C50)	–	–	–	–	–	–	–	9.3	9.0	9.6	10.7	0.97	1.03	1.14
Endocrine, nutritional and metabolic diseases (E00–E90)	28.6	32.9	30.7	30.2	1.15	1.07	1.06	13.9	14.0	13.3	12.6	1.00	0.96	0.91
Diabetes mellitus (E10–E14)	27.3	30.3	28.8	28.5	1.11	1.05	1.04	12.8	12.9	12.4	11.8	1.01	0.97	0.93
Mental and behavioural disorder (F01–F99)	15.6	15.9	13.3	10.6	1.02	0.85	0.68	3.6	2.9	2.8	1.7	0.82	0.79	0.47
Owing to the use of alcohol (F10)	12.2	13.3	10.6	8.6	1.09	0.87	0.70	0.5	0.6	0.6	0.4	1.35	1.40	0.79
Diseases of circulatory system (I00–I99)	150.8	138.9	124.8	111.6	0.92	0.83	0.74	79.9	67.9	58.4	50.4	0.85	0.73	0.63
Hypertensive disease (I10–I15)	11.3	6.6	5.3	3.9	0.59	0.47	0.35	8.2	4.4	3.1	3.2	0.53	0.38	0.39
Ischaemic heart disease (I20–I25)	24.5	28.0	30.8	31.3	1.14	1.26	1.28	6.9	8.0	9.3	9.3	1.16	1.34	1.35
Cardiomyopathy and conduction disorders (I42–I49)	19.9	17.7	13.1	8.3	0.89	0.66	0.42	5.3	4.9	3.9	2.6	0.91	0.73	0.48
Cerebrovascular disease (I60–I69)	79.4	71.5	66.1	61.3	0.90	0.83	0.77	49.7	41.6	36.3	31.5	0.84	0.73	0.63
Diseases of respiratory system (J00–J99)	22.2	25.8	24.6	17.9	1.16	1.11	0.81	6.4	7.7	7.5	5.5	1.21	1.17	0.86
Pneumonia (J12–J18)	4.3	7.1	6.6	3.3	1.65	1.52	0.76	1.2	2.1	1.7	0.9	1.69	1.38	0.75
Chronic lower respiratory disease (J40–J47)	10.0	8.2	9.4	9.2	0.82	0.93	0.91	3.6	2.9	3.2	3.1	0.81	0.87	0.85
Diseases of digestive system (K00–K93)	115.7	101.8	87.8	78.2	0.88	0.76	0.68	19.6	17.2	14.3	12.2	0.88	0.73	0.62
Liver diseases (K70–K77)	104.3	90.6	78.6	71.7	0.87	0.75	0.69	16.2	14.5	11.8	10.5	0.89	0.73	0.65
All external causes (V01–Y98)	155.5	149.4	125.0	114.9	0.96	0.80	0.74	43.9	40.4	36.4	32.1	0.92	0.83	0.73
Transport accidents (V01–V98)	76.5	52.9	50.3	36.4	0.69	0.66	0.48	23.1	14.9	15.3	10.6	0.65	0.66	0.46
Falls (W00–W19)	12.8	10.3	11.3	11.7	0.80	0.88	0.91	1.9	1.8	2.0	1.5	0.93	1.02	0.75
Accidental drowning (W65–W74)	5.7	7.3	5.9	3.1	1.29	1.03	0.54	1.2	1.7	1.4	0.7	1.43	1.19	0.56
Exposure to fire (X00–X09)	3.3	2.5	2.4	2.2	0.78	0.74	0.66	1.1	0.7	0.7	0.6	0.63	0.71	0.57
Accidental poisoning (X40–X49)	5.0	5.4	1.5	1.0	1.08	0.30	0.20	1.9	1.8	0.5	0.3	0.98	0.28	0.19
Suicide (X60–X84)	26.4	44.3	30.5	37.8	1.68	1.16	1.43	8.9	11.9	9.9	12.5	1.34	1.12	1.42
Homicide (X85–Y09)	3.1	3.6	2.7	2.7	1.14	0.88	0.87	2.1	2.7	2.2	1.8	1.30	1.05	0.86
Other causes	45.8	49.7	45.9	33.0	1.08	1.00	0.72	21.9	23.4	20.8	16.2	1.07	0.95	0.74

Table 3 Cause-specific age-standardized (to 2000 world population) mortality rates per 100 000 and calendar-year mortality rate ratios among South Korean males and females aged 65–79, 1996–2000

	Males aged 65–79							Females aged 65–79						
	Mortality rate (per 100 000)				Rate ratios			Mortality rate (per 100 000)				Rate ratios		
Cause of death	1996	1998	2000	2002	1998/1996	2000/1996	2002/1996	1996	1998	2000	2002	1998/1996	2000/1996	2002/1996
All causes	4730.9	4528.7	4228.6	3864.2	0.96	0.89	0.82	2683.9	2556.0	2386.5	2185.9	0.95	0.89	0.81
Infectious and parasitic diseases (A00–B99)	115.9	129.7	121.1	101.1	1.12	1.04	0.87	36.9	49.2	50.0	39.3	1.33	1.36	1.06
Tuberculosis (A15–A19)	94.1	87.2	78.8	70.6	0.93	0.84	0.75	24.0	22.9	22.3	19.5	0.95	0.93	0.81
All cancers (C00–C97)	1317.5	1295.5	1360.5	1382.4	0.98	1.03	1.05	502.7	481.9	520.5	515.5	0.96	1.04	1.03
Stomach cancer (C16)	335.8	306.5	285.4	280.2	0.91	0.85	0.83	129.2	107.3	106.5	96.5	0.83	0.82	0.75
Colorectal cancer (C18–C21)	68.3	69.0	82.4	98.3	1.01	1.21	1.44	43.1	44.0	52.2	54.6	1.02	1.21	1.27
Liver cancer (C22)	193.7	194.7	190.3	188.7	1.01	0.98	0.97	62.5	60.7	57.9	64.3	0.97	0.93	1.03
Lung cancer (C34)	341.5	347.8	401.1	403.6	1.02	1.17	1.18	78.4	78.0	87.1	87.0	0.99	1.11	1.11
Breast cancer (C50)	–	–	–	–	–	–	–	11.1	10.2	11.4	12.0	0.92	1.03	1.08
Endocrine, nutritional and metabolic diseases (E00–E90)	184.4	223.8	222.0	208.4	1.21	1.20	1.13	164.2	189.3	193.1	198.4	1.15	1.18	1.21
Diabetes mellitus (E10–E14)	177.0	209.0	209.6	201.7	1.18	1.18	1.14	157.3	178.8	183.1	190.6	1.14	1.16	1.21
Mental and behavioural disorder (F01–F99)	87.2	93.9	74.8	56.6	1.08	0.86	0.65	78.5	83.8	70.5	53.1	1.07	0.90	0.68
Owing to the use of alcohol (F10)	12.1	18.9	14.5	12.1	1.56	1.19	1.00	1.0	1.5	1.1	0.6	1.56	1.11	0.65
Diseases of circulatory system (I00–I99)	1340.6	1236.2	1111.2	1029.0	0.92	0.83	0.77	960.7	895.0	832.3	778.1	0.93	0.87	0.81
Hypertensive disease (I10–I15)	143.5	81.3	63.0	61.3	0.57	0.44	0.43	110.7	70.8	63.4	70.7	0.64	0.57	0.64
Ischaemic heart disease (I20–I25)	134.9	161.3	200.3	203.6	1.20	1.48	1.51	82.0	101.9	123.0	134.9	1.24	1.50	1.65
Cardiomyopathy and conduction disorders (I42–I49)	70.0	62.6	50.0	32.3	0.89	0.71	0.46	36.0	38.2	32.3	18.0	1.06	0.90	0.50
Cerebrovascular disease (I60–I69)	846.7	794.5	710.8	669.2	0.94	0.84	0.79	610.3	569.5	536.6	504.2	0.93	0.88	0.83
Diseases of respiratory system (J00–J99)	322.7	333.1	394.6	349.0	1.03	1.22	1.08	125.1	131.0	148.4	138.7	1.05	1.19	1.11
Pneumonia (J12–J18)	48.4	71.9	82.0	43.2	1.49	1.70	0.89	19.2	30.8	33.4	20.4	1.61	1.74	1.06
Chronic lower respiratory disease (J40–J47)	200.9	169.6	212.3	244.6	0.84	1.06	1.22	85.3	71.0	83.0	97.3	0.83	0.97	1.14
Diseases of digestive system (K00–K93)	271.1	241.1	208.8	170.4	0.89	0.77	0.63	105.0	99.8	87.3	73.3	0.95	0.83	0.70
Liver diseases (K70–K77)	182.7	153.0	141.0	118.2	0.84	0.77	0.65	53.1	48.2	42.3	39.1	0.91	0.80	0.74
All external causes (V01–Y98)	258.8	258.5	239.4	253.4	1.00	0.92	0.98	120.1	110.1	111.6	128.5	0.92	0.93	1.07
Transport accidents (V01–V98)	129.5	96.4	96.6	78.2	0.74	0.75	0.60	66.7	42.3	46.8	39.3	0.63	0.70	0.59
Falls (W00–W19)	25.3	26.6	31.3	29.8	1.05	1.24	1.18	11.1	13.3	14.4	20.4	1.20	1.30	1.84
Accidental drowning (W65–W74)	7.3	6.9	7.7	6.2	0.96	1.06	0.85	3.7	3.9	3.4	3.1	1.06	0.93	0.83
Exposure to fire (X00–X09)	7.3	4.2	5.3	5.3	0.58	0.73	0.73	2.5	2.0	2.4	2.2	0.79	0.96	0.86
Accidental poisoning (X40–X49)	14.2	14.8	4.3	3.5	1.05	0.31	0.25	5.7	5.8	3.3	2.2	1.02	0.57	0.39
Suicide (X60–X84)	42.4	58.5	49.1	71.1	1.38	1.16	1.68	15.8	22.3	20.8	31.2	1.41	1.32	1.97
Homicide (X85–Y09)	2.1	2.7	2.7	1.8	1.30	1.32	0.88	1.3	2.5	2.0	2.3	1.83	1.46	1.73
Other causes	832.7	716.9	496.2	314.0	0.86	0.60	0.38	590.7	515.9	372.5	261.2	0.87	0.63	0.44
Senility (R54)	629.2	477.8	270.9	134.4	0.76	0.43	0.21	449.8	336.4	197.1	102.8	0.75	0.44	0.23

similar to those aged 35–64. Death from stomach cancer, cerebrovascular disease, and liver disease accounted for ~30% of all-cause mortality and showed a stepwise decrease among both sexes aged 65–79. Another stepwise decrease was seen for tuberculosis (in both sexes), hypertensive disease, cardiomyopathy and conduction disorders (in males). A stepwise increasing pattern was found in colorectal cancer and ischaemic heart disease among both sexes, and lung cancer (in males) and diabetes mellitus (in females) between 1996 and 2002. Trends in rate ratios of transport accidents and suicidal death among the 65–79 year age group were similar to those among the 35–64 year age group, although the suicide mortality rate ratios in 2002 were greater than those in 1998. Death from falls in those aged 65–79 showed an increasing trend, which is different from those in the 35–64 year age group. While the homicide mortality rate ratio in males aged 65–79 decreased in 2002, homicide deaths in females of the same age increased during the economic crisis so that the mortality rate surpassed that of males in 2002. Death from alcohol dependence showed a 56% increase in 1998 among both sexes in this age group.

Mortality trends between 1990 and 2002 for selected causes of death

Figure 3 shows long-term mortality trends for selected causes of deaths among men and women aged 35–79 and is intended to provide a context for the shorter-term changes (1996–2002) described in the tables above. Trends in ages 35–64 and 65–79 were similar (data not shown). Mortality from cerebrovascular disease, stomach cancer, liver disease, and tuberculosis generally decreased from the early 1990s. Figure 3 also shows that the increasing trends in ischaemic heart disease, colorectal cancer, and breast cancer (in females) were not limited to the period of the economic crisis.

Discussion

Limitations of data

In South Korea, there has been no report questioning the completeness of death certificate data in the 1990s although there has been a concern about deaths among infants.[22] Changes in infant mortality were not examined in this study. However, a previous study, that combined South Korea's national health insurance data and crematorium data with death certificate data, revealed a decreasing tendency in both neonatal and post-neonatal mortality among infants of both sexes between 1996 and 1999.[22] Concerns have been expressed about the accuracy of Korean cause-of-death coding practices, the extent of which is unknown.[23] This inaccuracy may be greatest among those aged 65+. The physician-certified cause-of-death was lower in the 65+ age group as compared with the other groups and ill-defined causes such as 'senility (R54)' were often assigned. Not surprisingly, previous studies in South Korea revealed that death certification by a physician was a significant factor in improving the accuracy of reporting causes of death.[23,24] In this study, physician-certified deaths were 90.3% for ages 1–34, 82.0% for ages 35–64, and only 60.4% for ages 65+. A previous investigation showed that the proportion of death certification by physician was highest in external causes (90% or higher) followed by cancers and circulatory diseases.[25] We expect the data quality on external causes of death to be generally good, although the stigma attached to suicide may increase spurious reporting of unintentional causes such as falls and accidental drowning. Nevertheless, despite the less than ideal level of accuracy of cause-of-death coding, mortality trends are unlikely to be due to changes in the cause-of-death coding practice between 1996 and 2002.

Cause-specific patterns underlying declining all-cause mortality trends

The effects of the South Korean economic crisis on the consistent downward trends in all-cause mortality were weak for both sexes and all ages. As expected, the relative mortality declines (changes in rate ratios) were smaller in the elderly while the absolute ones were greater. Decreases in all-cause mortality among South Koreans aged 15–74 have been previously reported.[26] Given that the level of income inequality in South Korea increased massively with the economic crisis—approaching levels in Mexico and the US[3]—the simultaneous decline in mortality rates confirms the evidence derived from studies in rich countries[27–30] that there is no simple temporal relationship between changes in income inequality and changes in overall mortality. Murray and Chen have noted that the momentum of declining trends in age-specific mortality rates in most countries is highly resilient to various sorts of short-term socioeconomic shocks.[31]

The main contributing causes to the stepwise mortality decline between 1996 and 2002 were cerebrovascular accidents, liver cirrhosis, stomach cancer, and tuberculosis among both sexes aged 35–64 and 65–79. The first three causes accounted for ~30% of all deaths and thus significantly contributed to decreasing mortality. It is important to note the aetiological significance of early life exposures for cerebrovascular accidents (particularly haemorrhagic stroke that constitutes a substantial proportion of stroke deaths in Korea), stomach cancer, and tuberculosis.[32,33] In addition, declining levels of early life viral hepatitis B infection in successive generations in South Korea[34] might plausibly have played a role in declining liver cirrhosis mortality between 1996 and 2002. Furthermore, continuous improvements in living conditions after the Second World War and the Korean War (1950–53) might well have set in train cohort declines in early life infectious burden that later contribute to the large mortality reductions observed here. A previous study on agricultural growth in Korea between 1918 and 1971, showed that agricultural output declined markedly during the Second World War (1939–45) but continued to increase from the end of the Korean War.[35] According to a retrospective study, age at menarche, an indicator of physical development, showed no significant changes among Korean women born between 1920 and 1949 but, thereafter, showed a significant reduction for the following four decades (born between 1950 and 1986).[36] Using Japanese cancer mortality data, Gersten and Wilmoth showed that cancers linked to infection decreased since 1951 whereas cancers related to personal behaviours such as smoking or modern fertility patterns increased.[37]

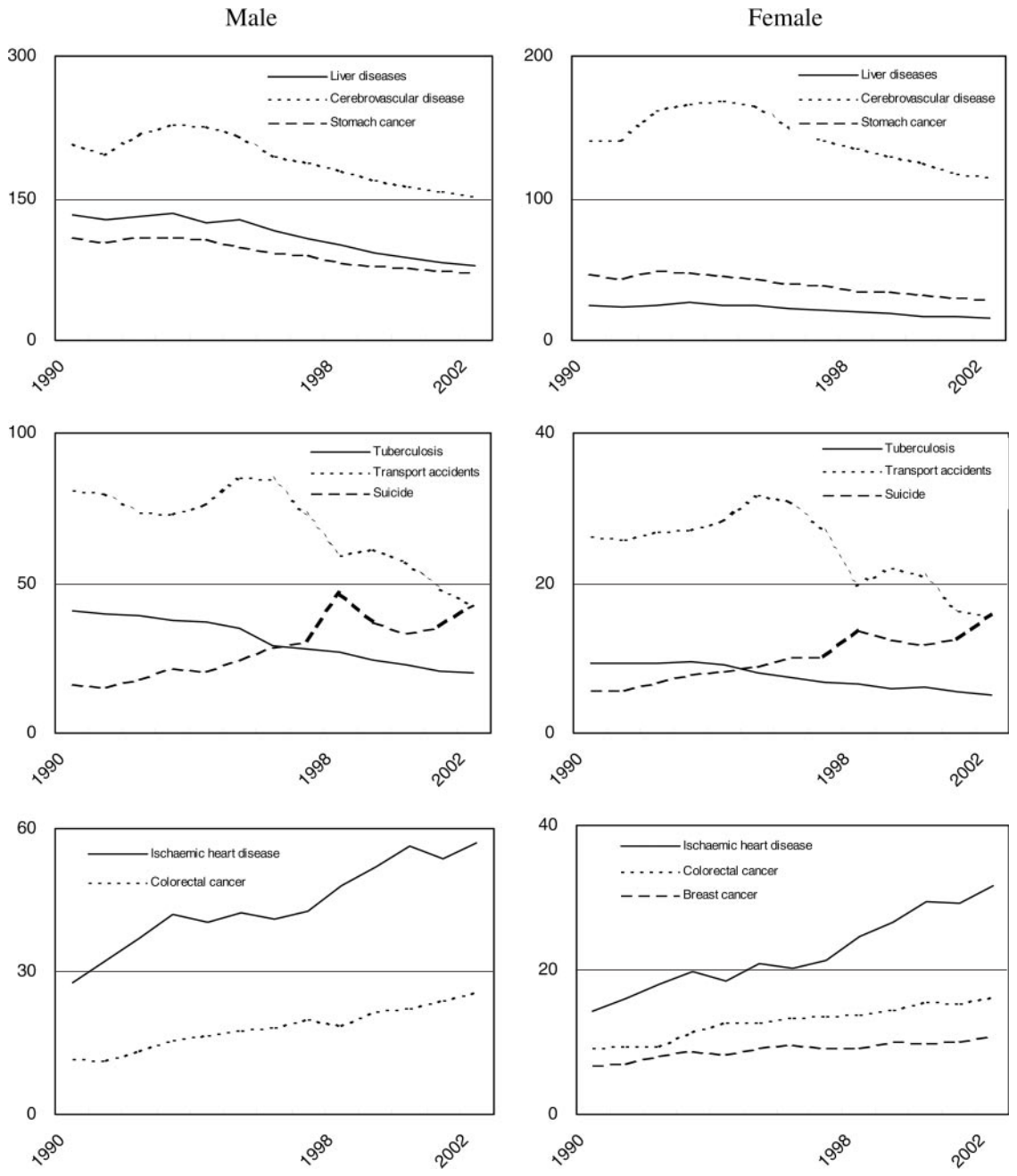

Figure 3 Trends in age-standardized mortality rate per 100 000 for selected causes of death at age 35–79 in South Korea, 1990–2002

Decline in transport accidents death

The reduction of transport accident deaths was dramatic, with the greatest decrease between 1996 and 1998. There may be an assumption that this dramatic decrease started before the economic crisis. However, the levels of transport accident mortality during early 1990s were not greater than those in 1996 (Figure 3). According to a report of the Korea Transport Institute, the price of gasoline (for automobiles) and light gasoline (for trucks) in 1998 increased by 36.1 and 64.7%, respectively, compared with the 1997 price.[38] As a result, consumption of gasoline and light gasoline decreased by 24.7 and 21.5%, respectively, and transport volume on expressways and national roads also decreased by 15.4 and 11.5%, respectively.[38] Between 1996 and 1998, traffic accidents decreased by 9.6% (from 265 052 to 239 721), although the number of total registered motor vehicles increased by the same proportion (from 9553 thousands to 10 470 thousands).[39] Further reduction in transport accident deaths between 2000 and 2002 is attributable to a nationwide traffic accident reduction campaign led by the Korean National Police Agency from 2001 (ahead of the 2002 Korea–Japan World Cup).[40]

Fluctuating mortality rates from suicide, homicide, and pneumonia

Based on the results of this study, the most important cause of death plausibly linked with the economic crisis would be suicide. Some of the increase in mortality from accidental drowning (at age 35–64) and falls (at age 65–79) during the economic crisis might be attributable to the avoidance of assigning suicide as the cause of death. The calendar-year rate ratios of suicide death varied with sex, age, and year. In 1998 when the economic crisis first overran South Korea, the greatest rise in the rate ratio was found in males aged 35–64 (rate ratio = 1.68). Unemployment may have played a great role in this rise. However, among both sexes aged 35–64 and 65–79, the suicide mortality rate returned to 1996 levels in 2000 and rose again in 2002. The resurgence in 2002 was most prominent among ages 65–79, while there was no increase among those aged 15–34. The elderly tend to kill themselves for different reasons (e.g. escaping from the torments of current suffering and loneliness) compared with adolescents.[41] In South Korea, the resurgence of suicide mortality in the elderly may be related to worsening old-age poverty associated with neo-liberal structural adjustment after the economic crisis.

Poverty and income inequality have been associated with homicide and other violent crimes.[42] According to an analysis of the national crime data, major crime (i.e. theft, homicide, robbery, and assault) increased in 1998 compared with 1997.[43] The increase in assault and bodily injury was the most salient (49.1%).[43] Our study showed that homicide mortality rate ratios varied with age and sex. Vulnerable groups such as children, the elderly, and women were most affected. Young male perpetrators might have attacked the vulnerable groups of South Korean society more often, thus accounting for the greater mortality rate ratios in those groups.

Pneumonia mortality rates increased 40–70% between 1998 and 2000 among both sexes aged 35–64 and 65–79. Although deteriorated host immunity caused by alcohol abuse[44] or nutritional problems (especially among the homeless) might increase pneumonia mortality, this hypothesis cannot explain the lowered tuberculosis mortality rate during the economic crisis and the decreased pneumonia mortality rates in 2002. Reduced health care accessibility might be another explanation. However, this also cannot explain the decrease in pneumonia mortality in 2002. Indeed, Yang *et al.*[45] indicated that level of utilization of health care services did not decrease during the economic crisis in South Korea. The pattern of a similar increase among both sexes and different age groups along with a similar decrease in 2002 implies that there have been exposures with ubiquitous infectivity. According to our analysis, most of the increase in pneumonia mortality in 1998 and 2000 occurred in the winter season (November–February) and suggests a possible role of influenza in the rise of pneumonia mortality.

Alcohol related death

Alcohol abuse is frequently a marker for acute social breakdown[46] and binge drinking may lead to sudden cardiac death.[47] In Russia, alcohol was a major proximal cause of fluctuation in mortality in the 1990s.[6–9] In South Korea, as in Western countries including the United States,[7] alcohol-related deaths were rarely assigned to the category of alcohol poisoning (X45). Results of this study show that death from alcohol dependence (F10) increased in 1998 among adults and the aged but accounted for a very small proportion of total mortality. Moreover, mortality from cardiomyopathy and conduction disorders as well as liver disease did not increase during the economic crisis. Alcohol-related death may be assigned to cardiovascular disease like ischaemic heart disease. However, graded increases in ischaemic heart disease mortality rates (as well as colorectal cancer mortality rates) during the economic crisis are more probably attributable to the accumulated costs of progressive adoption of a more Westernized lifestyle since the 1960s. According to the National Tax Administration data on alcoholic beverages, delivered quantity of alcoholic beverages per person decreased during the economic crisis: 87.4% in 1998, 90.3% in 2000, and 93.8% in 2002 compared with the 1996 level.[39] The National Health Survey of South Korea showed a decrease in the proportion of those drinking six drinks or more in one session between 1995 and 1998.[48,49] Along with declining hepatitis B infection, reduced per capita alcohol consumption is consistent with the observed decrease in liver disease mortality. Although economic decline has been associated with heavier alcohol use,[50] there is also evidence that economic recessions reduce alcohol consumption.[51]

Conclusion

There is little doubt that economic conditions are important determinants of population health in both the short[4–9] and long term.[52] The mortality crisis in Russia and the former Soviet Union showed the importance of socioeconomic conditions for health but the impact of economic crises on health may vary over place and time. The early 1990s' economic crisis in Finland, which caused a large upsurge in unemployment (<4% in 1990 to ~18% in 1994),[53] had few population health effects and was not associated with an increase in attempted and completed suicides.[54,55] The Finnish economic crisis was accompanied by a decrease in alcohol consumption[54] and the slowing down of the increase in mortality from alcohol related causes.[56] Both Finland and Russia have 'wet' drinking cultures, where a large proportion of alcohol drunk is in the form of spirits. The style of drinking in South Korea is broadly similar to Finland and Russia. Nevertheless, the economic crisis experienced in South Korea was as in Finland not translated into increased binge drinking and deaths due to cardiovascular disease, highlighting the importance of understanding specific details of drinking culture within countries. The health impact of economic crises may depend on (i) the depth and length of the crisis and (ii) the buffering capacity of a society. The modest impact of the Korean economic crisis on mortality suggests two possible explanations. One is that the depth of the economic crisis in South Korea was deeper than in Finland, but not as deep as in Russia and the former Soviet Union. The other is that the social safety net in South Korea was relatively weak compared with Finland and could not buffer against sudden adverse economic and health effects of an economic crisis.

Conflict of interest: None declared.

KEY MESSAGES

- Few studies have focused on the impact of East Asian economic crises on mortality. This study provides a systematic analysis of the mortality effects of the economic crisis on South Korean citizens.
- Suicide mortality increased during the economic crisis. A remarkable decrease in transport accident mortality rates was observed. However, short-term mortality effects of the South Korean economic crisis were relatively small.
- It appears that any short-term effects of the economic decline were overwhelmed by the momentum of large declines in causes of death such as stroke, stomach cancer, and liver disease, which are probably related to exposures with much longer aetiological periods.

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