

Statistical Data

Change in Causes of Injury-Related Deaths in South Korea, 1996–2006

Juhee Hong^{1,2}, Won Kyung Lee², and Hyesook Park²

¹Office of Policy Development, Seoul Welfare Foundation, Seoul, Korea

²Department of Preventive Medicine, School of Medicine, Medical Research Center, Ewha Womans University, Seoul, Korea

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ABSTRACT

Background: The aims of this study were to describe temporal patterns of injury-related mortality by sex, age group, and mechanism, and to identify changes in the leading causes of injury-related deaths in South Korea from 1996 through 2006.

Methods: This retrospective, descriptive study analyzed national data on all injury-related deaths reported in official death certificates from 1996–2006. Incidence rates of fatal injuries are presented as crude and age-standardized rates per 100 000 population, and percentage changes in injury-related mortalities over the 11-year period were calculated with respect to intention, sex, and age. The 4 most common mechanisms (fall, poisoning, suffocation, and drowning) were then classified as unintentional injuries or suicides.

Results: Overall injury-related mortality decreased 31.7% during the study period (1996–2006). Despite this overall decreasing trend, injury-related mortality increased among adults aged 65 years or older. In particular, injury-related mortality among women older than 80 years doubled since 1996. Suicide replaced transport as the leading cause of injury-related deaths between 2003 and 2006. With regard to intention, sex, and age, the most noticeable changes during the study period were increases in unintentional fall among elderly adults and suicidal fall among adolescents.

Conclusions: The incidence rate for all injuries generally decreased from 1996–2006. However, the incidence rate of fall injuries increased among elderly adults, and suicide increased among adolescents. These findings suggest that further investigation of the characteristics and trends of injuries is necessary to develop and implement effective interventions.

Key words: injuries; falls; safe community; suicide; surveillance

INTRODUCTION

In 2004, injury was the third most frequent overall cause of death in South Korea but the leading cause of death in the most productive age groups.¹ Injury-related death rates in South Korea were 3 to 4 times those of Sweden, the United Kingdom, Italy, and the Netherlands,² and the proportion of injury-related deaths to total deaths in South Korea was the second highest (12.4%) among countries in the Organization for Economic Co-operation and Development (OECD).³ Multisectoral efforts to improve safety and reduce injury appear to have decreased the overall injury-related mortality rate in South Korea. However, there are no recent epidemiologic data on secular trends and changes in patterns of fatal injury at the national level. Without this information, it is impossible to implement a system to plan, evaluate, and modify nationwide injury-prevention programs or to adjust

interventions or countermeasures in response to changes in injury patterns.^{4,5} Moreover, previous research in this field has largely focused on crude rates, with less attention on age-standardized rates,⁶ which exclude the effect of recent trends in South Korea, ie, its decreasing population and aging society. Therefore, the aims of this study were to examine the overall temporal pattern of injury-related mortality according to sex, age group, and mechanism, and to identify any changes in the leading causes of injury-related deaths in South Korea during 1996–2006.

METHODS

This retrospective descriptive study analyzed national data on all reported injury deaths from 1996 through 2006. All available life table and annual mortality data were drawn from the Korea National Statistical Office (NSO). Mortality data

Address for correspondence: Hyesook Park, Department of Preventive Medicine, School of Medicine, Ewha Womans University, 911-1 Mok-6-dong, Yangcheon-Gu, Seoul 158-710, South Korea (e-mail: hpark@ewha.ac.kr).

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included the number of deaths by cause, sex, and age group for each year since 1983. Cause of death was diagnosed and coded by physicians according to the International Classification of Diseases, 10th Revision (ICD-10) for all years.⁷ The mortality data are open to the public and are analyzed by many researchers.^{8,9}

Cause of death was categorized by mechanism and intention using the ICD-10 codes. Complications of medical and surgical care (Y40–Y84) and sequelae of external causes of morbidity and mortality (Y85–Y89) were excluded. The defined injury mechanisms were traffic accident (V01–V99, X82, Y03, Y32, Y361, U011), poisoning (X40–X49, X60–X69, X85–X90, Y10–Y19, Y352, U016–U17), suffocation (W75–W84, X70, X91, Y20), falling (W00–W19, X80, Y01, Y30), drowning (W65–W74, X71, X92, Y21), fire (X00–X19, X76–X77, X97–X98, Y26–Y27, Y363, U013), and firearms (W32–W34, X72–X74, X93–X95, Y22–Y24, Y350, U014). The intent of injury was categorized as unintentional injury (V01–X59), suicide (X60–X84), or homicide (X85–Y09).

Two age-based categories were created to enable measurement of incidence variation with age: (1) 17 age groups with 5-year intervals (ie, 0–4 years, 5–9 years, 10–14 years, etc. up to 80–84 years), and (2) 5 age groups with nonuniform intervals (0–6 years, 7–18 years, 19–44 years, 45–64 years, and 65 years or older). Adult, middle aged, aged were defined as 19 to 44 years, 45 to 64 years, and 65 years or older in Medline. Those younger than adults were defined as preschool children (0 to 6 years) and children/adolescents (7 to 18 years), based on entrance into elementary school.

Fatal injury rates are presented as crude and age-standardized rates (per 100 000 population). Crude rates were estimated as the number of injury-related deaths divided by the population in the middle of the calendar year. Using a direct method, the age-standardized rates were calculated as the number of injury-related deaths (sorted into 5-year age groups) divided by the population value (also sorted into 5-year age groups) in the middle of the calendar year. The population in 2000, which is approximately the middle of the study period, was selected for standardization. Data on the South Korean population for the period 1996–2006 were obtained from the census published by the Korea National Statistical Office. Percentage changes in injury-related death rates relative to intention, sex, and age, over the 11-year study period were calculated using the value for the difference between the 1996 and 2006 values divided by the 1996 value. The 4 most common injury mechanisms for both unintentional and intentional injuries (fall, poisoning, suffocation, and drowning) were divided by intention (ie, unintentional injury or suicide). Changes in injury-related deaths according to mechanism over the study period (ie, proportion of injury-related deaths according to mechanism in 1996 compared with those in 2006) were calculated according to intention, sex, and age group.

Table 1. Annual deaths and crude and age-standardized injury-related mortality rates, 1996–2006

| | Number | Crude rate ^a | Age-standardized rate ^a |
|------|--------|-------------------------|------------------------------------|
| 1996 | 34 341 | 74.6 | 77.5 |
| 1997 | 32 422 | 69.8 | 71.9 |
| 1998 | 31 922 | 68.2 | 69.7 |
| 1999 | 29 863 | 63.3 | 64.1 |
| 2000 | 28 799 | 60.6 | 60.6 |
| 2001 | 28 638 | 59.8 | 58.9 |
| 2002 | 28 713 | 59.7 | 57.6 |
| 2003 | 31 460 | 65.1 | 61.6 |
| 2004 | 30 481 | 62.9 | 58.0 |
| 2005 | 30 864 | 63.4 | 57.3 |
| 2006 | 29 504 | 60.4 | 52.9 |

^aRate per 100 000 population.

RESULTS

Between 1996 and 2002 there were substantial decreases in the annual numbers of deaths and in crude and standardized injury-related death rates. Over the entire study period, the age-standardized rate decreased from 77.5 to 52.9. However, in 2003 there were sudden increases in the number and rate of injury-related deaths, with steady decreases thereafter through 2006 (Table 1).

Figure 1 shows the change in injury-related deaths between 1996 and 2006 by age group. The reduction was greatest in children aged 0 to 4 years (–65%). The extent of the reduction then decreased with increasing age until approximately age 65 years, after which the rate of injury-related deaths increased. In adults 80 years or older the rate increased by 100%. Sex had no effect on these findings.

Regarding injury mechanism, the number of transport injury-related deaths showed the greatest decline (from 39.5 to 14.4 per 100 000) over the 11-year study period. There was an increasing mortality trend for fall, suffocation, and poisoning, but a decreasing trend for drowning (Figure 2). The leading cause of injury-related deaths was transport-related injury from 1996 through 2002, but suicide was the leading cause during and after 2003 (data not shown).

Figure 3 presents the trends in injury-related death rates by intention. Most falls and drownings occurred unintentionally, but most poisonings and suffocations were suicides. Death rates for intentional fall, poisoning, suffocation, and drowning peaked slightly in 1998 and then increased steadily or fluctuated from 2002. In contrast, death rates for unintentional poisoning, suffocation, and drowning decreased over the 11-year study period, as did overall injury-related death rates. However, death rates for unintentional fall increased steadily after 2001.

Between 1996 and 2006, the greatest changes were seen for unintentional fall (+16%) and unintentional transport injury-related deaths (–14%). Suicide by fall and suffocation increased by approximately 2% in 2006 as compared with 1996. Both suicidal and unintentional poisoning decreased by 2% to 3% over the 11-year period (Figure 4).

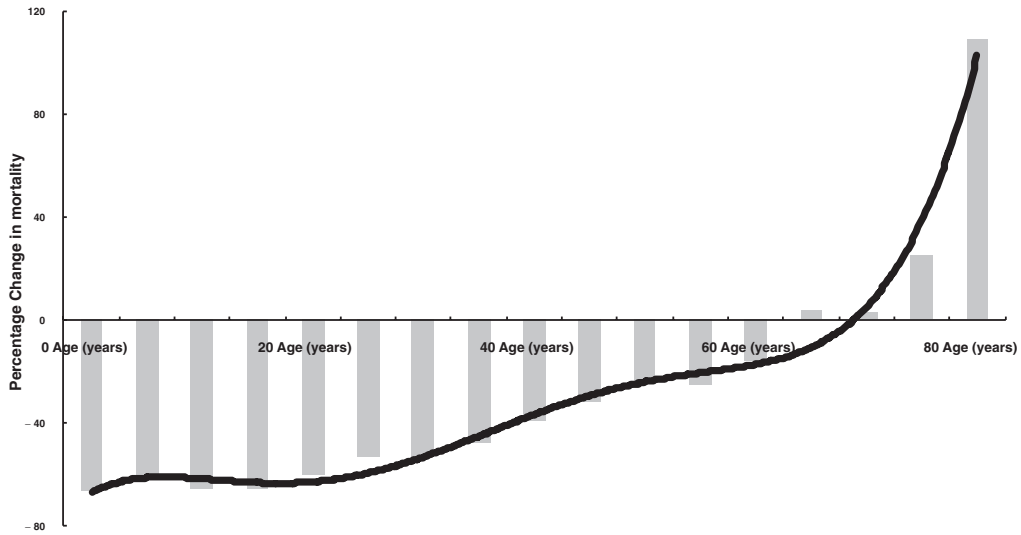


Figure 1. Percentage change in injury-related mortality rate between 1996 and 2006 by age group

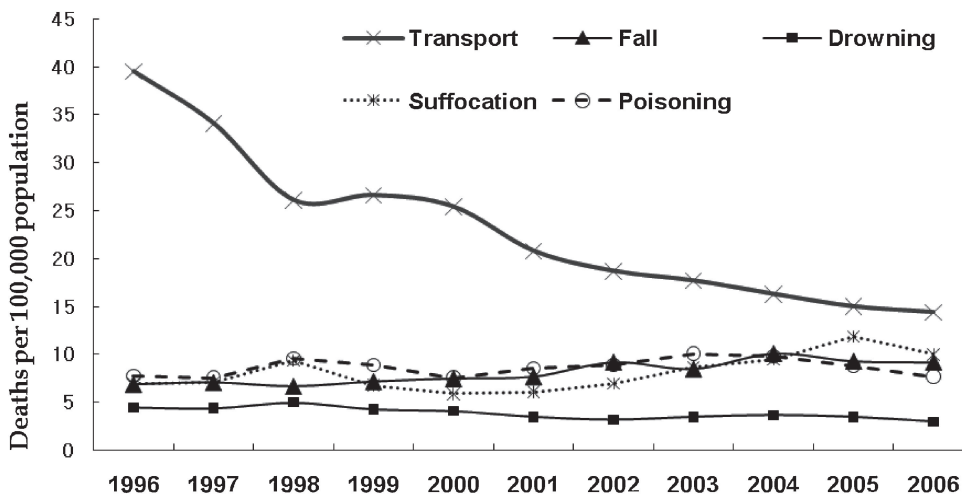


Figure 2. Injury-related death rates per 100 000 population by mechanism, 1996–2006

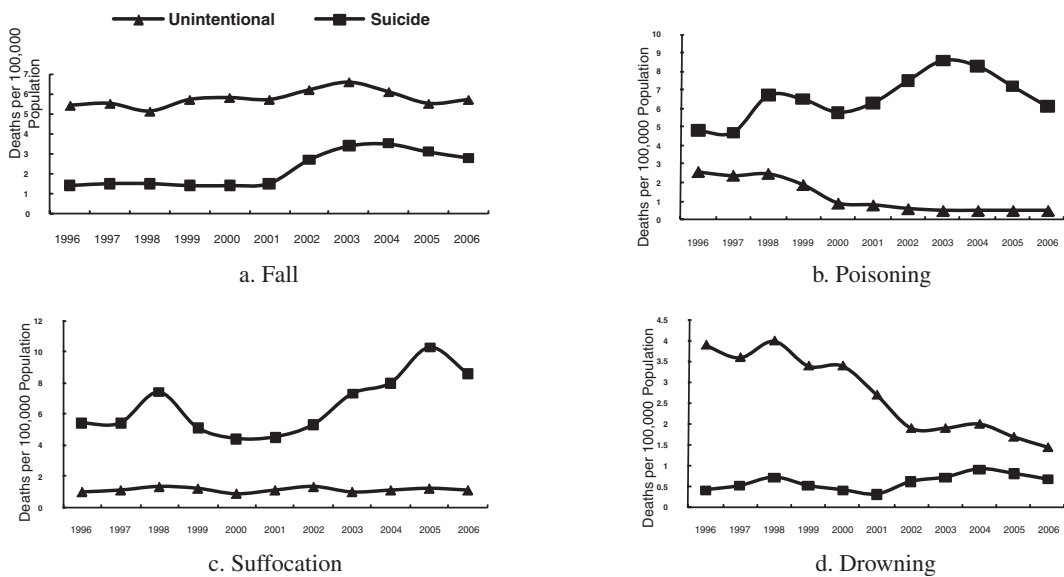


Figure 3. Death rates by intention, 1996–2006

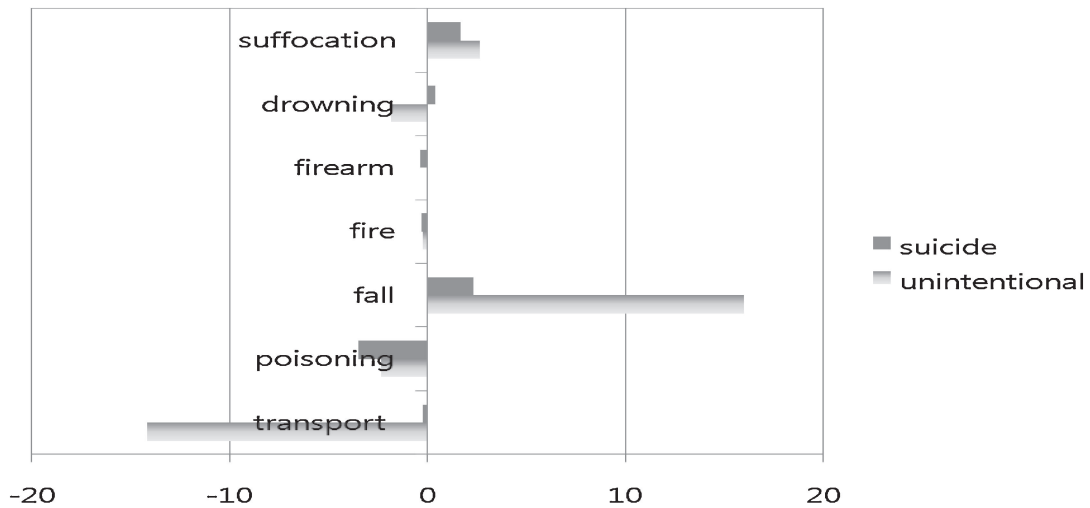


Figure 4. Percentage changes in injury-related mortality rates between 1996 and 2006, by intention

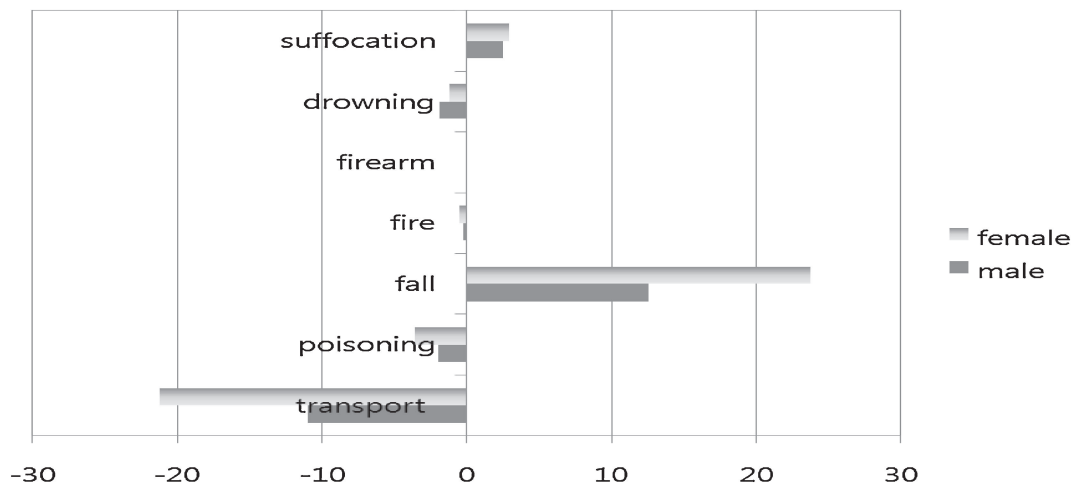


Figure 5. Percentage changes in unintentional injury-related mortality rates between 1996 and 2006, by sex

The most noticeable percentage changes in injury-related deaths by sex were increased unintentional fall (+24%) and decreased unintentional transport-related injury (-21%) among females. Among males, the percentage increase in fall and decreases in transport-related injuries and poisoning between 1996 and 2006 were much lower than those for females (Figure 5). Similarly, the percentage change in suicide among males was much lower than that for females (data not shown).

Figure 6 shows the percentage changes in unintentional injuries by age group from 1996 to 2006. The greatest increase (24%) was seen for fall among elderly persons aged 65 years or older, and the greatest decrease (22%) was for transport-related injury among elderly adults aged 65 years or older. In preschool children, unintentional fire (+3%) and fall (+4%) slightly increased and unintentional transport-related injury (-7%) and suffocation-related injury (-5%) decreased. In school-aged children, unintentional fall, fire, and suffocation slightly increased and unintentional poisoning and drowning were slightly lower. In adults aged 19 to 44 years,

unintentional fall and suffocation increased, but transport-related injury and poisoning decreased. In middle-aged adults, unintentional fall increased by 9% and transport-related injury decreased by 10%. The percentage changes in unintentional fall and suffocation increased with increasing age, and the greatest changes were seen after age 65 years (Figure 6).

Figure 7 shows percentage changes in suicide by age group. The most notable changes were increased suicidal fall (+28%) and decreased suicidal poisoning (-22%) among children and adolescents aged 7 to 18 years; the overall suicide rate decreased. In adults aged 19 to 64 years, suicidal poisoning decreased and suicide by fall and suffocation slightly increased over the study period. After age 65 years, suicide by poisoning increased and suicide by suffocation decreased.

DISCUSSION

The overall injury-related death rate decreased by 31.7% between 1996 and 2006. There were initial secular decreases

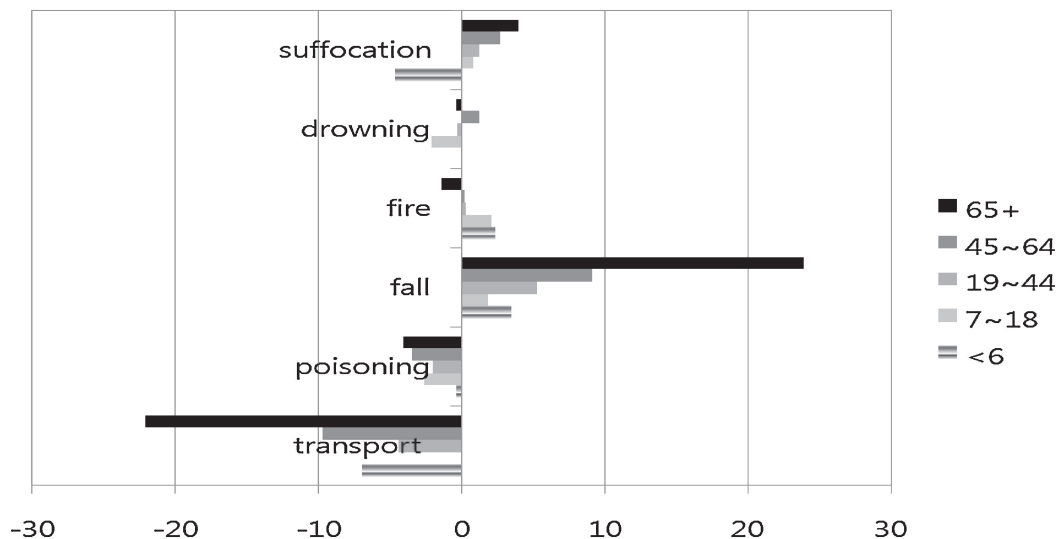


Figure 6. Percentage changes in unintentional injury-related mortality rates between 1996 and 2006, by age group

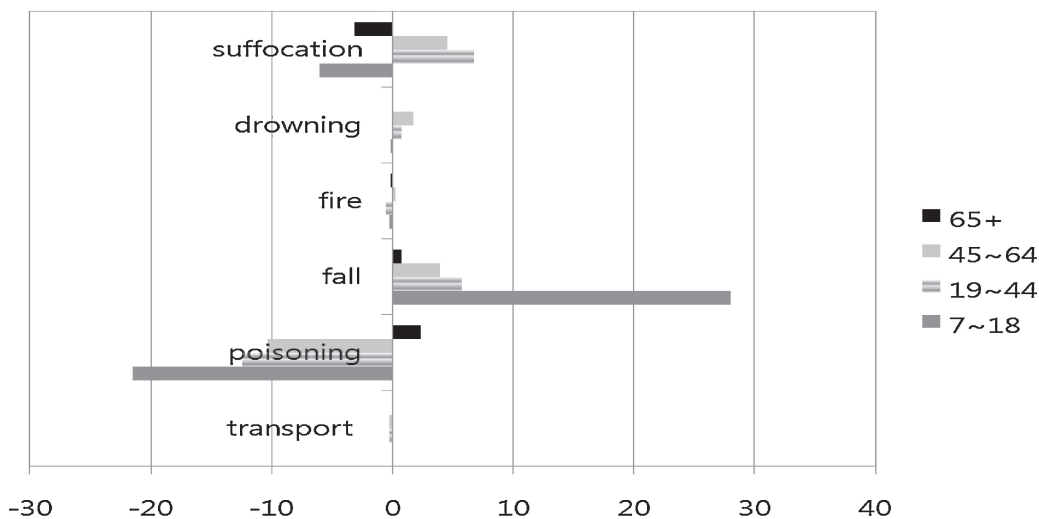


Figure 7. Percentage changes in suicide rate between 1996 and 2006, by age group

in age-standardized rates of injury-related deaths through to 2002, followed by a sudden increase in 2003 and a subsequent steady decrease to 2006. Despite this decreasing trend over the years, there was an increasing trend among adults aged 65 years or older, especially in women aged 80 years or older, among whom injury-related death rates more than doubled.

Strikingly, the suicide rate increased from 13.2 to 19.3 per 100 000 during the study period. Suicide was the leading cause of injury-related death and began to surpass transport-related deaths in 2003. According to the World Health Organization (WHO), approximately 1 million people worldwide died of suicide in 2002.¹⁰ Some Western countries have experienced declining suicide trends since the mid- or late 1990s^{11,12}; however, there has been a substantial increase in the rate of suicides in Asian countries during the same period.¹³ The suicide rate in Korea was consistently lower than that of Japan before 1990. However,

from the mid-1990s, there was a sudden increase in suicides in Korea and finally surpassed Japan from the mid-1990s.¹⁴ Korea began to suffer from increased unemployment and declining household income in the mid-1990s and received an emergency rescue loan from the International Monetary Fund (IMF) in 1997.^{13,15}

The method of suicide differs between countries. The US Centers for Disease Control¹⁶ and the WHO¹⁷ reported that most suicides were carried out with a firearm. In Lithuania¹² and South Africa¹⁸ the most common methods of suicide are hanging, strangulation, and suffocation. In China most suicides appear to be carried out by poisoning (ingestion of pesticide or rat poison), or by charcoal burning among middle-aged men in Hong Kong.¹⁹ In Taiwan, charcoal burning and jumping from an extreme height are most prevalent.²⁰ In our study, the most common method of suicide was suffocation, followed by poisoning and fall. This may explain the increases in overall death rates by suffocation, poisoning, and fall

among those older than 19 years, which are consistent with other studies showing that the preferred suicide methods were hanging and pesticide poisoning in Korea and hanging in Japan, according to OECD health data.¹⁴

We observed a large decrease in the rate of transport-related deaths, which agrees with previous reports. This marked decline could be attributable to concerted efforts to reinforce legislation, establish traffic systems and effective traffic safety programs, and improve trauma care.²¹ Various efforts have also been made in South Korea to legislate enforcement and education programs to control speed, alcohol consumption, and hand-held mobile phone use while driving, and to require the use of seat belts and child restraints in cars and helmets on motorcycles and motorbikes.²² However, despite the overall decline in transport-related deaths, the extent of the decline among children and adolescents younger than 18 years was not as great as for other age groups; thus, this age group had the highest rate of injury-related deaths. This finding is partially consistent with the findings of other studies, which found that although transport injury-related deaths have declined among children and adolescents,^{4,23,24} such deaths remained the leading cause of injury-related death.¹⁷

There is general agreement among studies that the rate of fall-related injuries increases with increasing age²⁵; our findings support this consensus. This rise has been attributed to aging of the population, longer survival after chronic disease (which results in greater frailty and hence more falls), increased intake of drugs, and lower levels of physical activity. However, there are inconsistent findings regarding sex differences in the increase in fall-related unintentional injuries. Some studies reported an increase among females, similar to our finding,²⁶ but other studies reported an increase among males.^{21,27}

We observed an increase in suicidal fall among children and adolescents aged 7 to 18 years from 1996 to 2006. In the present study there was a much higher increase in falls due to suicide among individuals aged 7 to 18 years, as compared with rates for adults and elderly adults. These findings suggest that Korean children and adolescents are more likely to fall from buildings and apartments than to overuse toxic drugs or hang themselves.

Implications

Although there has been a recent slight downward trend in Korea, suicide was the leading cause of injury-related deaths after 2003. This suicide epidemic has been overlooked for too long, and societal responses in South Korea have been mostly reactive rather than preventive. Further analysis of the characteristics and trends of injuries is necessary in order to develop and implement suitable interventions.

Strengths

This is the first study to explore time trends in injury-related deaths by using the most recent nationwide data up to 2006

in South Korea. Therefore, the findings are based on representative and precise data.

Limitations

The dataset for this study did not provide sufficiently detailed information to explain the reasons for the differences in the observed time trends. Therefore, the study is descriptive rather than explanatory. Our findings highlight an abrupt change in the injury-related death rate in 2003, but offer no explanation for this specific finding. Moreover, the trend toward a general increase in injury-related deaths among elderly women could not be analyzed and must therefore be left for future research.

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Conflicts of interest: The authors report no conflicts of interest.

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