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# The Evolution of Unintentional Injury Mortality Among Elderly in Europe

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**Objectives:** To compare cause-specific unintentional injury mortality trends among elderly (65+) in the European Union over a 10-year period. **Method:** Overall and cause-specific data for 23 out of the 29 EU and European Free Trade Association countries with population ≥ 1,000,000 were retrieved from the World Health Organization (WHO), and age-standardized mortality rates for the first and last 3 available years of the study period were calculated. Proportional mortality changes were estimated through linear regression. **Results:** Circa 1993, country-specific rates varied widely (>fourfold), but this gap is closing and a statistically significant downward trend in overall mortality is noted circa 2002, in about half of the countries. Rates from falls were reduced by 4.3%, from motor vehicle traffic by 3.1%, and from smoke, fire, and flames by 3.1%. **Discussion:** A large proportion of EU countries enjoys steady declining trends by major unintentional injury mortality category. Success factors and barriers underlying these benchmarking patterns should be further explored to accelerate the process of injury reduction.

***Keywords:*** *cause-specific mortality; elderly; Europe; trend; unintentional injuries*

## Introduction

For the first time in the recorded history of medicine, mortality among the elderly is declining as fast as mortality among the younger ages. The question now is how to tackle the unacceptable fraction of mortality because of preventable injuries and how to improve the quality of life for the elderly. Moreover, the increasing life expectancy worldwide calls for specific action to address preventable causes of morbidity and mortality among the elderly.

Injury has been recognized as an important public health problem with an enormous impact on disability, occupational performance, and death (WHO, 2000). With more than 5 million deaths every year, violence and injuries account for 9% of global mortality (Krug, 2004). According to the National Vital Statistics Preliminary Report for 2004, unintentional injuries represent the ninth leading cause of death for people more than 65 years old in the United States (Minino, Heron, & Smith, 2006), whereas in the European Union (EU-25) alone, approximately 160,500 deaths each year are because of unintentional injuries, out of which approximately 78,000 deaths occur among seniors (more than 65 years old; Injury Statistics, 2005). Mortality and hospitalization, however, represent only the tip of the injury iceberg. Indeed, nonfatal injuries to persons who sought care at the accident and emergency departments constitute a major cause of suffering and functional impairment among injured people and their families, resulting in variable degrees of impairment or disability and substantial increase of health care costs.

In a recent European study, it was estimated that if all EU member states could match the achievements of the country with the lowest unintentional injury mortality rate among the elderly, two fifths (39%) of unintentional injury fatalities among the elderly could be avoided, and approximately 30,000 lives would be been saved (Petridou, Kyllekidis, Chishti, Dessypris, & Stone, 2006). These findings highlight a great potential for the reduction of injury-related deaths among the elderly through the establishment of effective prevention strategies.

The evidence of single-factor or multifactorial interventions (Kannus, Sievanen, Palvanen, Jarvinen, & Parkkari, 2005) on the prevention of injuries among older people is steadily growing. Several strategies have shown to be effective in the prevention of falls among elderly people, including regular strength and balance training (Carter, Kannus, & Khan, 2001; Li et al., 2005;

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Li, Harmer, Fisher, & McAuley, 2004; Lord et al., 2003; Sinaki et al., 2002), vitamin D and calcium supplementation (Bischoff-Ferrari et al., 2004; Chapuy et al., 1992 Chapuy et al., 2002; Dawson-Hughes, Harris, Krall, & Dallal, 1997; Trivedi, Doll, & Khaw, 2003), reduction of the number and doses of psychotropic medication (Campbell, Robertson, Gardner, Norton, & Buchner, 1999), cataract surgery (Harwood et al., 2005; Schwartz et al., 2005), and professional home-hazard assessment and management in people with a history of falling (Gillespie et al., 2003).

Highlighting of achievements in prevention is an important means of focusing the attention of policy makers and government fund holders to well-funded preventive strategies. The mapping of injury mortality rates across the EU and European Free Trade Association (EFTA) countries can prove to be a simple monitoring scheme of interest to those involved in public health policy making, as well as to those caring for population groups or communities. The aims of this study are to explore the pattern of unintentional injury-related mortality among the elderly European population over a recent 10-year period, to determine country-specific differences, and to compare trends within countries by major causes of injury-related death.

## Method

All current EU-25 and EFTA countries were included in the study, with the exception of three EU member states (Cyprus, Luxembourg, Malta) and two EFTA countries (Iceland, Liechtenstein) with population less than a million, because small numbers may be subject to excessive random variation. Data from Switzerland were also excluded because they are available only in gross categories. Eventually, the following 23 countries were included in the analysis : Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Norway, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

For the purpose of this study, the analysis was restricted to elderly 65+ years old who died within the last available decade for each country, circa 1993-2002. Mortality data for unintentional injury and corresponding denominator population estimates for the relevant countries were retrieved from the mortality database of the European Office of the World Health Organization (WHO Europe; World Health Organization Statistical Information System [WHOSIS]) using the respective causes of death coded under International Classification of Diseases, ninth or tenth revision (ICD9 or ICD10) classification. It was decided to use only these two coding versions

to increase the comparability of the data among countries and years in the same country.

Concerning Denmark, the data used for the analysis refer to a 7-year period because of the use of the ICD8 coding system prior to 1994, whereas United Kingdom data for 2000 and Poland data for 1997-1998 were not available; therefore the analysis was restricted to 9 and 8 years, respectively. Finally, because of incomplete information on "other unintentional unspecified injuries" for Latvia (1993-1995) and Estonia (1993) that would affect the analysis, the study period was restricted to 7 and 9 years, respectively, for the above-mentioned member states.

Five unintentional injury mortality categories have been constructed for the purposes of this project and were common for both coding versions: (a) accidental falls (ICD9 and ICD10 corresponding codes: E880-E888 and W00-W19, respectively); (b) motor vehicle traffic injuries (ICD9 and ICD10 corresponding codes: E810-E819 and V2-V4, V9, V12-V14, V19-V79, V803-V805, V821, V830-V833, V840-V843, V850-V853, V86-V89, respectively); (c) accidental poisoning (ICD9 and ICD10 corresponding codes: E850-E869 and X40-X49, respectively); (d) smoke, fire, and flames (ICD9 and ICD10 corresponding codes: E890-E899 and X00-X09, respectively); and (e) accidental drowning and submersion (ICD9 and ICD10 corresponding codes: E910 and W65-W74, respectively). Annual average age-standardized specific unintentional injury mortality rates (standardized mortality rate [SMR]) based on the first and last 3 available years, and the European standard population provided by WHO, were then estimated to smooth any artifact variations because of the diverse age structure between European countries.

Whether the "other or unspecified unintentional injuries" category includes different types of unintentional injury is a matter for debate, especially in view of the change of classification from ICD9 to ICD10 at some point during the study period (Anderson, Minino, Hoyert, & Rosenberg, 2001). We, therefore, also calculated the percentage of other specified categories of injuries (misadventures during medical care, transport nonmotor vehicle accidents, machinery cutting and piercing injuries, firearm missile, miscellaneous) and other unspecified injuries among all unintentional injury deaths during the first and last 3 available years (UnS1 and UnS2, respectively) of the study period for each country, as well as their difference (Δ[UnS2-UnS1]). Furthermore, for the prevailing category, namely, accidental falls, we performed two calculations of the SMR including and excluding "other or unspecified unintentional" injuries. Thus, we opted to examine if the "other or unspecified unintentional injuries" category that was added to the large

category of "accidental falls" would have any implication on the reported changes across the different EU and EFTA countries during the study period.

The proportional annual mortality changes (SMR %) of the various unintentional injury categories among the different EU and EFTA countries during the study period were represented by the use of a linear regression model. To determine the statistical significance of the mortality trends for each member state, the 95% confidence interval and associated *p* value were calculated. The SAS statistical package was used (SAS Institute Inc, 1989).

## Results

The age-standardized injury mortality rate among the EU and EFTA countries shows a wide, more than fourfold variation (from 58 to 280 per 100,000 person-years) during the first part of the study period (Table 1). Specifically, there were three countries with rates lower than 70 injury deaths per 100,000 person-years (United Kingdom, Spain, and Greece) and three countries with rates higher than 200 injury deaths per 100,000 person-years (Hungary, the Czech Republic, and Slovenia). The variation gap is closing somewhat, and the difference between the country with the highest and lowest rate has fallen from 280 to 212 per 100,000 person-years and 60 to 58 per 100,000 person-years, respectively, during the study period. During this latter period, the rate for Germany substantially decreased to ~60, and the rates for the Czech Republic and Slovenia decreased below 200 injury deaths per 100,000 person-years.

Concerning the annual mortality change, a statistically significant downward trend was observed in about 50% of the countries (Table 1 and Figure 1). The map of Figure 2 shows the evolution of injury mortality in the EU and EFTA countries during the study period. Specifically, (a) six new member states of EU with high SMR in the starting period of the study experienced statistically significant reduction of injury mortality rates: Slovakia (–11%), Slovenia (–6%), the Czech Republic (–6%), Hungary (–4%), Estonia (–3%), and Poland (–2%); (b) five old member states with average SMR in the starting period of the study experienced moderate and statistically significant mortality reductions (Germany, Italy, the Netherlands, Austria, and Belgium); (c) Norway and four member states of EU with high SMR in the starting period of the study did not show any evidence in making progress (Lithuania, France, Denmark, and Finland); on the contrary a statistically significant increase (3%) was noted in the newer member state of Latvia; and finally (d) the six countries with the lowest SMR in the starting period of the study, namely, three Southern European member states (Spain, Greece,

*(text continues on page 168)*

**Table 1**
**Ranking of the Regression-Derived Percentage Annual Change of the Age-Standardized Mortality Rates (SMR) Per 100,000 Person-Years Because of Unintentional Injuries Among Elderly (65+ Years) in EU-25 and EFTA Countries (Excluded: States With <1,000,000 Inhabitants) Along With Average SMR and Percentage of Other Specified and Other Unspecified Unintentional Injuries (UnS1, UnS2 for the First and Last 3 Available Years) and Their Difference: Δ(UnS2–UnS1)**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | SMR Last 3 Years Average (Rank[a]) | % UnS1 | % UnS2 | Δ(UnS2–UnS1) | SMR % Annual Change | 95% Confidence Interval | | *p* Value |
|---|---|---|---|---|---|---|---|---|---|
| Slovakia (92) | 175.3 (4) | 78.0 (18) | 9 | 21 | 12 | –10.9 | –14.36 | –7.29 | .0005 |
| Slovenia (92) | 207.3 (3) | 136.4 (7) | 18 | 17 | –1 | –6.1 | –7.50 | –4.59 | .0001 |
| Czech Republic (93) | 237.7 (2) | 157.8 (4) | 12 | 14 | 2 | –5.6 | –7.01 | –4.27 | .0001 |
| Germany (92) | 91.9 (17) | 63.5 (21) | 9 | 22 | 13 | –5.2 | –6.41 | –3.94 | .0001 |
| Hungary (93) | 280.4 (1) | 212.1 (1) | 9 | 10 | 1 | –3.8 | –4.69 | –2.81 | .0001 |
| Estonia (94) | 134.7 (11) | 112.7 (11) | 19 | 31 | 12 | –3.3 | –5.90 | –0.73 | .04 |
| Italy (92) | 125.7 (12) | 104.5 (12) | 10 | 10 | 0 | –2.6 | –3.17 | –2.10 | .0001 |
| Poland (93) | 141.2 (8) | 118.1 (10) | 11 | 18 | 7 | –2.4 | –3.15 | –1.56 | .001 |
| Portugal (93) | 85.5 (20) | 72.4 (19) | 16 | 28 | 12 | –2.3 | –4.46 | 0.05 | NS |
| Netherlands (91) | 93.2 (15) | 79.5 (17) | 10 | 57 | 47 | –2.3 | –3.21 | –1.34 | .002 |
| Austria (93) | 92.9 (16) | 83.0 (16) | 12 | 17 | 5 | –1.6 | –2.84 | –0.32 | .04 |
| Belgium (88) | 114.4 (14) | 102.2 (13) | 22 | 19 | –3 | –1.5 | –2.48 | –0.46 | .02 |

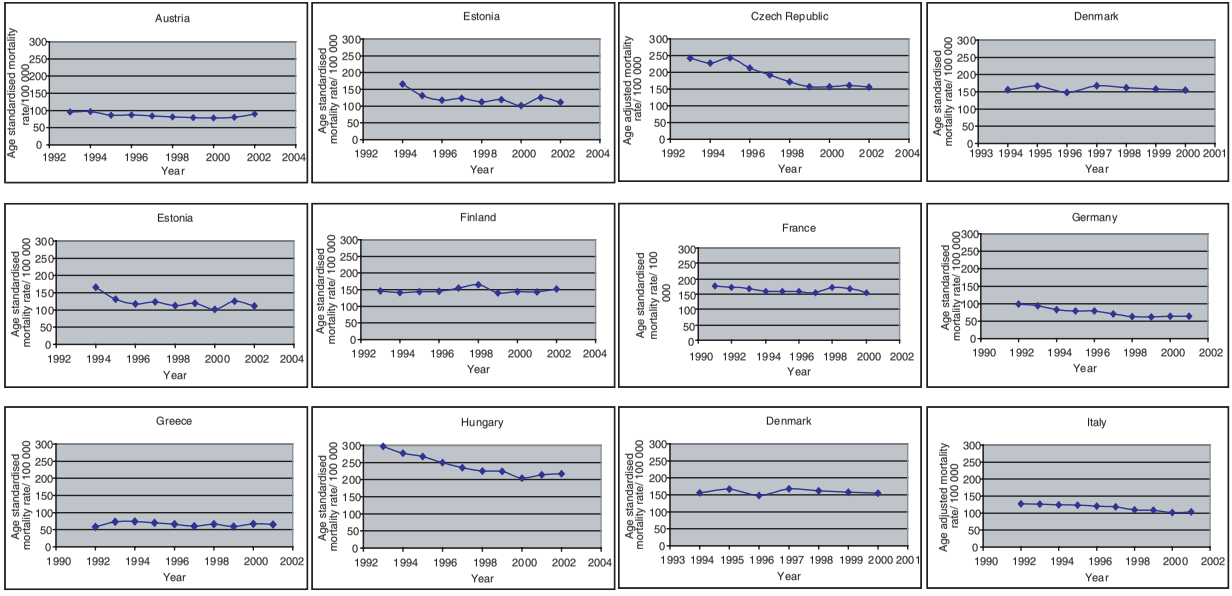
*(continued)*

**Table 1 (continued)**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | SMR Last 3 Years Average (Rank[a]) | % UnS1 | % UnS2 | Δ(UnS2–UnS1) | SMR % Annual Change | 95% Confidence Interval | | *p* Value |
|---|---|---|---|---|---|---|---|---|---|
| Lithuania (93) | 139.3 (9) | 124.2 (9) | 22 | 26 | 4 | –1.2 | –2.66 | 0.26 | NS |
| France (91) | 171.8 (5) | 165.1 (2) | 36 | 47 | 11 | –0.7 | –1.67 | 0.26 | NS |
| Greece (92) | 68.7 (21) | 63.7 (20) | 17 | 11 | –6 | –0.6 | –2.44 | 1.31 | NS |
| Norway (92) | 135.3 (10) | 132.9 (8) | 9 | 16 | 7 | –0.3 | –1.38 | 0.72 | NS |
| Spain (92) | 61.0 (22) | 60.3 (23) | 36 | 40 | 4 | –0.2 | –1.08 | 0.69 | NS |
| Denmark (94) | 156.9 (6) | 158.1 (3) | 6 | 23 | 17 | –0.2 | –1.91 | 1.63 | NS |
| Finland (93) | 144.1 (7) | 146.5 (6) | 15 | 14 | –1 | 0.2 | –0.90 | 1.38 | NS |
| Sweden (92) | 90.3 (18) | 91.3 (15) | 23 | 63 | 40 | 0.5 | –0.62 | 1.67 | NS |
| United Kingdom (93) | 57.7 (23) | 61.5 (22) | 18 | 50 | 32 | 0.7 | –0.05 | 1.39 | NS |
| Ireland (92) | 86.5 (19) | 94.7 (14) | 10 | 11 | 1 | 1.5 | –0.50 | 3.57 | NS |
| Latvia (96) | 122.9 (13) | 152.4 (5) | 5 | 22 | 17 | 3.0 | 1.32 | 4.74 | .02 |
| EU–25 and EFTA | 113.5 | 98.2 | 18 | 30 | 12 | –2.6 | –3.41 | –1.76 | .0003 |

Source: WHO mortality database, last available decade (c. 1993-2002) adjusted by the Center for Research and Prevention of Injuries.
Note: EFTA = European Free Trade Association.
a. (1) = highest, (23) = lowest SMR.

**Figure 1**
**Unintentional Injuries: Time Trends of the Age-Standardized Mortality Rate (SMR) Per 100,000 Person-Years Among Elderly (65+ Years) in EU-25 and EFTA Countries, Excluding States With <1,000,000 Inhabitants During the Study Period (c. 1993-2002)**




*(continued)*

## Figure 1 (continued)

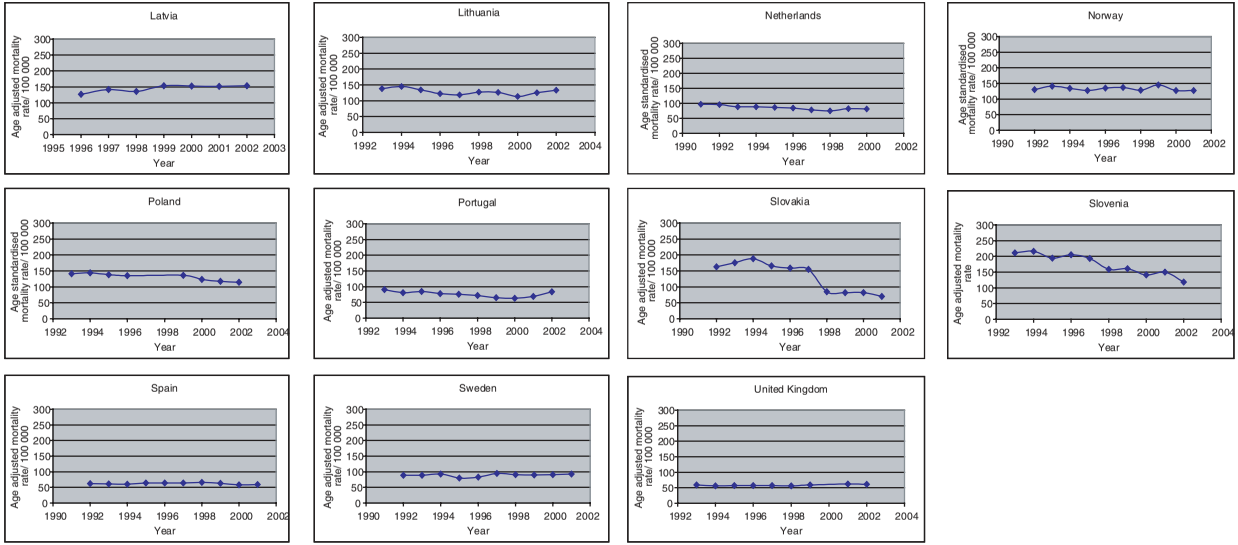
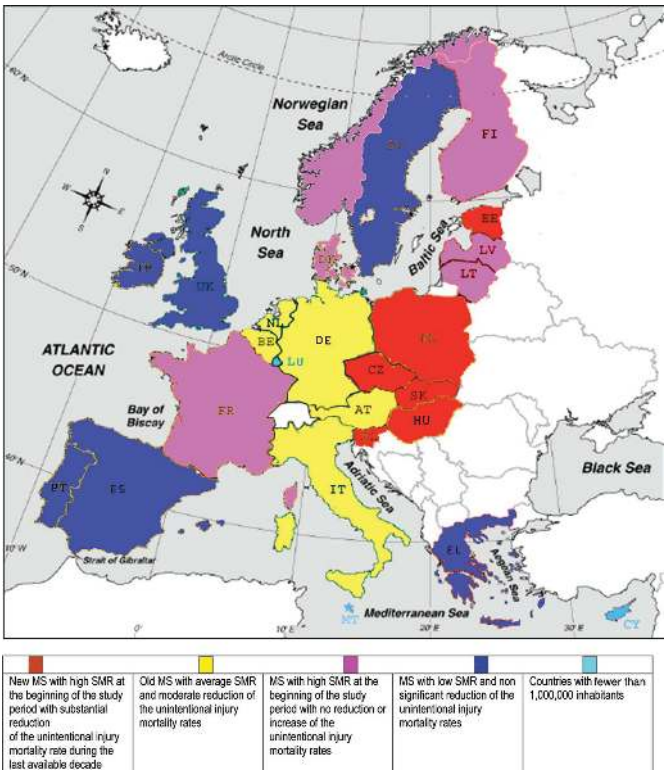


**Figure 2**
**Unintentional Injuries: Schematics of the Regression-Derived Percentage Annual Change of the Age-Standardized Mortality Rates (SMR) Per 100,000 Person-Years Among Elderly (65+ years) in EU-25 and EFTA Countries, Excluding States With <1,000,000 Inhabitants During the Study Period (c. 1993-2002)**




Note: Only study countries are shown. The boundaries and names shown and the designations employed and the presentation of this map do not imply any expression whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

and Portugal), United Kingdom, Ireland, and Sweden, have not yielded to any statistically significant reductions of the injury mortality rates. The overall annual change of EU and EFTA countries displayed a statistical significant decreasing trend of 2.6%.

## Causes of Injury

The five top specified causes of death because of unintentional injury over the last available 3 years of the study period were accidental falls (~51%); motor vehicle traffic accidents (~13%); smoke, fire, and flames; accidental poisoning; and accidental drowning and submersion (~2%, each) (data not shown). Other specified categories of injuries (misadventures during medical care, transport nonmotor vehicle accidents, machinery cutting and piercing injuries, firearm missile, miscellaneous) account for ~7%, whereas the "other or unspecified unintentional injuries" category in the most recent period accounts for as high as 23% (Injury Statistics, 2005).

A statistically significant decrease in age-adjusted mortality rates in EU-25 and EFTA countries was observed for accidental falls (–4.3%), motor vehicle traffic accidents (–3.1%), and smoke, fire, and flames (–3.1%). However, the above changes should be interpreted with caution, especially with regard to countries such as Sweden and the United Kingdom because of the considerable increase in the percentage of the unintentional unspecified causes of injury deaths in the last part of the study period.

*Accidental falls.* The age SMR because of falls shows an even wider variation than that because of overall injuries (from 14 deaths to 217 deaths per 100,000 person-years) among the EU and EFTA countries during the first part of the study period. Specifically, there were two countries with rates ≤ 15 injury deaths per 100,000 person-years (Spain and Greece) and two countries with rates higher than 150 injury deaths (Hungary and the Czech Republic).

Table 2 shows a statistically significant downward trend in 65% of the countries; indeed, most of the studied countries experienced a decrease of the respective rates over the study period with the exception of 5 countries, out of which a statistically significant annual increase was noted in Latvia (8%) and Ireland (4%). Sizeable statistically significant decreases in rates over the study period occurred in most of the new member states with high-age-adjusted unintentional injury mortality rates at the beginning of the period under study.

When figures of the "other or unspecified unintentional injuries" category were added to these of the accidental falls category, the downward trend, overall, retained the statistical significance for EU and EFTA countries during the study period. Only in the United Kingdom, a statistically significant change of the trend was noted when the "other or unspecified unintentional injuries" were added to the accidental falls. Nevertheless, for eight more countries, the age SMR for the combination of the two categories increased at the end of the study period, but no changes in the statistical significance were observed.

**Table 2**
**Accidental Falls**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | % SMR Annual Change | 95% CI | | *p* Value |
|---|---|---|---|---|---|
| Accidental falls alone | | | | | |
| Slovakia (92) | 124.1 (4) | –17.3 | –23.12 | –11.08 | .0009 |
| Netherlands (91) | 65.1 (12) | –15.8 | –21.68 | –9.52 | .002 |
| Sweden (92) | 52.5 (15) | –12.7 | –16.80 | –8.41 | .0005 |
| Denmark (94) | 120.5 (5) | –8.3 | –18.94 | 3.81 | NS |
| Germany (92) | 65.7 (11) | –8.0 | –9.45 | –6.56 | .0001 |
| Estonia (94) | 39.0 (18) | –6.5 | –10.52 | –2.22 | .02 |
| Czech Republic (93) | 177.2 (2) | –6.2 | –7.68 | –4.74 | .0001 |
| Slovenia (92) | 129.5 (3) | –5.7 | –7.32 | –3.99 | .0002 |
| France (91) | 82.6 (10) | –5.1 | –9.06 | –0.94 | .04 |
| United Kingdom (93) | 32.7 (20) | –4.4 | –7.39 | –1.27 | .03 |
| Portugal (93) | 31.1 (21) | –4.4 | –6.32 | –2.38 | .003 |
| Hungary (93) | 216.9 (1) | –3.7 | –4.57 | –2.88 | .0001 |
| Poland (93) | 84.8 (9) | –3.3 | –4.23 | –2.36 | .0005 |
| Austria (93) | 58.3 (14) | –2.3 | –3.18 | –1.36 | .001 |
| Italy (92) | 85.1 (8) | –2.2 | –3.08 | –1.40 | .0008 |
| Norway (92) | 103.3 (6) | –1.7 | –2.92 | –0.44 | .03 |
| Belgium (88) | 59.4 (13) | –0.2 | –1.64 | 1.29 | NS |
| Lithuania (93) | 36.3 (19) | –0.2 | –2.90 | 2.63 | NS |
| Greece (92) | 15.0 (22) | 0.0 | –4.71 | 5.04 | NS |
| Spain (92) | 13.5 (23) | 0.3 | –2.90 | 3.63 | NS |
| Finland (93) | 89.0 (7) | 0.7 | –0.75 | 2.25 | NS |
| Ireland (92) | 48.1 (16) | 3.9 | 1.57 | 6.29 | .01 |
| Latvia (96) | 44.2 (17) | 8.1 | 3.23 | 13.12 | .02 |
| EU-25 and EFTA | 67.0 | –4.3 | –5.01 | –3.68 | .0001 |
| Accidental falls combined with other unintentional unspecified injuries | | | | | |
| Slovakia (92) | 129.7 (4) | –15.4 | –20.93 | –9.53 | .001 |
| Germany (92) | 71.7 (12) | –5.9 | –7.27 | –4.45 | .0001 |
| Czech Republic (93) | 191.5 (2) | –5.5 | –7.06 | –3.94 | .0001 |
| Slovenia (92) | 134.4 (3) | –5.1 | –6.72 | –3.43 | .0004 |
| Hungary (93) | 229.7 (1) | –3.6 | –4.53 | –2.67 | .0001 |
| Estonia (94) | 46.9 (18) | –3.3 | –5.91 | –0.59 | .05 |
| Italy (92) | 95.1 (9) | –2.5 | –3.20 | –1.73 | .0002 |
| Greece (92) | 21.3 (23) | –2.2 | –7.45 | 3.35 | NS |
| Poland (93) | 93.3 (10) | –2.1 | –3.03 | –1.22 | .004 |
| Netherlands (91) | 71.9 (11) | –2.0 | –3.01 | –0.98 | .005 |
| Austria (93) | 64.0 (15) | –1.6 | –2.81 | –0.29 | .04 |

*(continued)*

**Table 2 (continued)**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | % SMR Annual Change | 95% CI | | *p* Value |
|---|---|---|---|---|---|
| France (91) | 129.4 (5) | –0.7 | –1.71 | 0.42 | NS |
| Portugal (93) | 36.4 (21) | –0.6 | –4.67 | 3.69 | NS |
| Belgium (88) | 67.6 (13) | 0.0 | –1.31 | 1.41 | NS |
| Norway (92) | 109.7 (7) | 0.1 | –1.19 | 1.32 | NS |
| Spain (92) | 31.7 (22) | 0.6 | –0.74 | 1.97 | NS |
| Sweden (92) | 66.2 (14) | 0.7 | –0.41 | 1.90 | NS |
| Lithuania (93) | 47.5 (17) | 0.9 | –1.27 | 3.14 | NS |
| Finland (93) | 100.0 (8) | 1.0 | –0.44 | 2.36 | NS |
| Denmark (94) | 126.6 (6) | 1.7 | –0.35 | 3.70 | NS |
| United Kingdom (93) | 38.6 (20) | 2.5 | 1.70 | 3.35 | .0005 |
| Ireland (92) | 52.0 (16) | 3.9 | 1.40 | 6.55 | .02 |
| Latvia (96) | 44.2 (19) | 6.3 | 3.06 | 9.56 | .01 |
| EU-25 and EFTA | 81.1 | –2.6 | –3.59 | –1.60 | .001 |

Source: WHO mortality database, last available decade (c. 1993-2002) adjusted by CEREPRI.
Note: Ranking of the regression-derived percentage annual change of the age-standardized mortality rate (SMR) per 100,000 person-years among elderly (65+ years), excluding and including other unintentional unspecified injuries, with 95% confidence intervals (95% CI) in EU-25 and EFTA countries excluding states with <1,000,000 inhabitants.
a. (1) = highest, (23) = lowest SMR.

*Motor vehicle traffic accidents.* Despite the fact that the actual motor vehicle traffic SMR rates are of lower values compared to those of accidental falls, a threefold variation can be observed among the EU and EFTA countries (ranging from 10 to 36 deaths per 100,000 person-years) during the study period. Specifically, there were four countries (United Kingdom, Sweden, Norway, and Germany) with rates lower than 15 injury deaths per 100,000 person-years and three countries (Portugal, Slovenia, and Lithuania) with rates higher than 30 injury deaths per 100,000 person-years because of motor vehicle traffic accidents at the beginning of the study period.

The decreasing trends were independent of the values observed in the starting rates. Countries with low SMR, like United Kingdom, Sweden, Germany, and the Netherlands, demonstrated statistically significant decreasing trends, comparable to countries with high starting SMRs (Portugal, Slovenia, and Lithuania). On the other hand, countries that did not reach any significant decline presented either with high (Greece, Latvia, Slovakia) or very low SMRs (Norway and the Czech Republic).

**Table 3**
**Motor Vehicle Traffic Accidents and Smoke, Fire, and Flames**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | % SMR Annual Change | 95% CI | | *p* Value |
|---|---|---|---|---|---|
| Motor vehicle traffic accidents | | | | | |
| Estonia (94) | 19.2 (11) | –9.6 | –12.93 | –6.22 | .001 |
| Slovenia (92) | 34.9 (2) | –8.8 | –10.72 | –6.86 | .0001 |
| Denmark (94) | 18.4 (13) | –8.5 | –14.07 | –2.52 | .04 |
| Portugal (93) | 35.7 (1) | –5.3 | –8.07 | –2.37 | .008 |
| United Kingdom (93) | 9.7 (23) | –5.0 | –5.78 | –4.25 | .0001 |
| Ireland (92) | 17.6 (14) | –5.0 | –8.72 | –1.05 | .04 |
| Germany (92) | 12.9 (20) | –4.8 | –5.85 | –3.81 | .0001 |
| Sweden (92) | 10.6 (22) | –4.6 | –6.12 | –3.01 | .0005 |
| Italy (92) | 23.2 (9) | –4.2 | –5.20 | –3.19 | .0001 |
| Netherlands (91) | 15.7 (18) | –4.1 | –5.34 | –2.86 | .0002 |
| Lithuania (93) | 30.4 (3) | –4.0 | –6.58 | –1.34 | .02 |
| Hungary (93) | 23.6 (8) | –3.8 | –5.24 | –2.29 | .001 |
| Finland (93) | 16.3 (17) | –3.0 | –4.85 | –1.11 | .01 |
| Poland (93) | 27.5 (6) | –3.0 | –4.02 | –1.93 | .002 |
| Belgium (88) | 22.7 (10) | –2.9 | –4.20 | –1.68 | .002 |
| Austria (93) | 17.3 (16) | –2.8 | –5.20 | –0.41 | .05 |
| Slovakia (92) | 23.7 (7) | –2.7 | –5.30 | 0.06 | NS |
| Latvia (96) | 28.2 (5) | –2.6 | –7.25 | 2.36 | NS |
| France (91) | 17.6 (14) | –2.4 | –3.29 | –1.55 | .0007 |
| Norway (92) | 11.4 (21) | –1.4 | –3.40 | 0.62 | NS |
| Spain (92) | 19.0 (12) | –1.0 | –1.81 | –0.18 | .04 |
| Greece (92) | 28.9 (4) | –0.5 | –2.51 | 1.61 | NS |
| Czech Republic (93) | 15.6 (19) | 0.4 | –4.97 | 5.98 | NS |
| EU-25 and EFTA | 18.0 | –3.1 | –3.63 | –2.47 | .0001 |
| Smoke, fire, and flames | | | | | |
| Finland (93) | 4.3 (8) | –11.5 | –15.98 | –6.72 | .002 |
| Czech Republic (93) | 3.3 (13) | –7.8 | –10.56 | –4.86 | .0009 |
| Poland (93) | 4.1 (9) | –6.6 | –9.04 | –4.16 | .002 |
| Hungary (93) | 8.0 (5) | –6.6 | –8.93 | –4.19 | .0008 |
| Austria (93) | 2.2 (17) | –6.4 | –10.90 | –1.63 | .03 |
| Slovakia (92) | 4.1 (9) | –6.3 | –11.25 | –1.13 | .05 |
| Denmark (94) | 4.4 (7) | –6.2 | –10.05 | –2.21 | .03 |
| Ireland (92) | 8.1 (4) | –5.6 | –10.72 | 0.05 | NS |
| France (91) | 2.6 (14) | –5.5 | –7.55 | –3.48 | .0008 |
| Lithuania (93) | 10.6 (3) | –5.2 | –9.23 | –1.05 | .04 |
| Germany (92) | 1.9 (20) | –5.2 | –7.30 | –3.07 | .002 |
| United Kingdom (93) | 2.6 (14) | –4.7 | –6.34 | –2.96 | .001 |

*(continued)*

**Table 3 (continued)**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | % SMR Annual Change | 95% CI | | *p* Value |
|---|---|---|---|---|---|
| Greece (92) | 5.1 (6) | –4.2 | –7.03 | –1.18 | .03 |
| Italy (92) | 2.0 (18) | –3.8 | –5.24 | –2.31 | .001 |
| Spain (92) | 1.9 (20) | –3.7 | –6.30 | –1.01 | .03 |
| Portugal (93) | 3.4 (12) | –3.0 | –7.25 | 1.40 | NS |
| Estonia (94) | 24.9 (1) | –3.0 | –5.73 | 0.05 | NS |
| Netherlands (91) | 1.6 (23) | –2.3 | –5.89 | 1.52 | NS |
| Slovenia (92) | 2.0 (18) | –2.0 | –15.89 | 14.12 | NS |
| Norway (92) | 3.5 (11) | –2.0 | –6.17 | 2.30 | NS |
| Latvia (96) | 23.6 (2) | –0.6 | –7.64 | 6.94 | NS |
| Sweden (92) | 2.4 (16) | 1.9 | –2.28 | 6.18 | NS |
| Belgium (88) | 1.9 (20) | 3.6 | –0.31 | 7.64 | NS |
| EU-25 and EFTA | 2.9 | –3.1 | –5.01 | –1.21 | .01 |

Source: WHO mortality database, last available decade (c. 1993-2002) adjusted by CEREPRI.
Note: Ranking of the regression-derived percentage annual change of the age-standardized mortality rate (SMR) per 100,000 person-years among elderly (65+ years), with 95% confidence intervals (95% CI) in EU-25 and EFTA countries excluding states with <1,000,000 inhabitants.
a. (1) = highest, (23) = lowest SMR.

*Smoke, fire, and flames.* Significant variation is observed among the EU and EFTA countries (ranging from a low 1.6 to a high 24.9 deaths per 100,000 person-years); specifically, there were four countries (the Netherlands, Germany, Spain, Belgium) with rates lower than 2 injury deaths per 100,000 person-years, whereas the three Baltic countries (Estonia, Latvia, and Lithuania) experienced rates higher than 10 starting injury deaths per 100,000 person-years. The vast majority of the countries (21 out of the 23 countries) showed decreasing trends through the study period, which in 14 countries reached statistical significance (Table 3, Smoke, fire, and flames) leading to an overall significant downward trend in the EU and EFTA countries. Only Sweden and Belgium, countries with low starting rates, had nonstatistically significant increased trends.

*Accidental poisoning.* The average SMR during the first 3 years of the study period for accidental poisoning among the EU and EFTA countries showed a variation ranging from ≤1 deaths (the Netherlands, Portugal, Austria, Germany) to >10 deaths per 100,000 person-years (Lithuania and Estonia). Statistically significant gains for the prevention of accidental poisoning are seemingly noted (Table 4, Accidental poisoning) in several

**Table 4**
**Accidental Poisoning and Accidental Drowning and Submersion**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | % SMR Annual Change | 95% CI | | *p* Value |
|---|---|---|---|---|---|
| Accidental poisoning | | | | | |
| Denmark (94) | 2.0 (11) | –27.3 | –36.42 | –16.83 | .006 |
| Czech Republic (93) | 8.6 (4) | –12.4 | –19.52 | –4.68 | .02 |
| Austria (93) | 1.0 (20) | –11.0 | –15.74 | –5.90 | .003 |
| Hungary (93) | 3.3 (9) | –9.3 | –11.28 | –7.29 | .0001 |
| Poland (93) | 5.9 (6) | –6.6 | –8.81 | –4.44 | .001 |
| Belgium (88) | 3.6 (8) | –6.0 | –11.08 | 0.05 | NS |
| Slovenia (92) | 2.1 (10) | –5.1 | –13.79 | 4.43 | NS |
| United Kingdom (93) | 1.2 (19) | –4.1 | –6.24 | –1.89 | .009 |
| Slovakia (92) | 3.7 (7) | –4.0 | –9.83 | 2.13 | NS |
| Italy (92) | 1.4 (16) | –3.9 | –5.94 | –1.91 | .006 |
| Netherlands (91) | 0.5 (23) | –3.9 | –15.43 | 9.15 | NS |
| Norway (92) | 1.8 (13) | –3.2 | –12.20 | 6.66 | NS |
| Germany (92) | 1.0 (20) | –2.6 | –12.35 | 8.27 | NS |
| Spain (92) | 1.4 (16) | –2.4 | –5.25 | 0.58 | NS |
| Portugal (93) | 0.7 (22) | –2.1 | –10.68 | 7.33 | NS |
| Lithuania (93) | 15.1 (1) | 0.6 | –3.35 | 4.74 | NS |
| Estonia (94) | 14.8 (2) | 1.2 | –5.46 | 8.24 | NS |
| Greece (92) | 1.5 (14) | 1.2 | –6.65 | 9.62 | NS |
| Finland (93) | 8.3 (5) | 1.3 | –1.92 | 4.57 | NS |
| Latvia (96) | 8.7 (3) | 2.5 | –8.29 | 14.61 | NS |
| Ireland (92) | 1.5 (14) | 4.0 | –5.42 | 14.46 | NS |
| Sweden (92) | 1.4 (16) | 5.6 | –0.12 | 11.74 | NS |
| France (91) | 2.0 (11) | 13.1 | 7.32 | 19.12 | .002 |
| EU-25 and EFTA | 2.2 | 0.9 | –1.56 | 3.34 | NS |
| Accidental drowning and submersion | | | | | |
| Denmark (94) | 1.3 (19) | –7.4 | –20.33 | 7.70 | NS |
| Hungary (93) | 3.0 (9) | –6.4 | –9.78 | –2.89 | .008 |
| Italy (92) | 1.4 (18) | –5.6 | –7.64 | –3.51 | .0009 |
| Czech Republic (93) | 5.6 (5) | –5.5 | –9.25 | –1.51 | .03 |
| Estonia (94) | 11.2 (3) | –5.2 | –14.36 | 4.93 | NS |
| Lithuania (93) | 16.7 (1) | –4.4 | –6.44 | –2.26 | .004 |
| Germany (92) | 1.2 (20) | –4.3 | –5.74 | –2.85 | .0004 |
| Netherlands (91) | 0.8 (22) | –2.3 | –11.05 | 7.41 | NS |
| Poland (93) | 3.4 (8) | –2.2 | –5.16 | 0.80 | NS |
| Spain (92) | 3.0 (9) | –2.0 | –3.83 | 0.05 | NS |
| Austria (93) | 2.0 (14) | –0.8 | –4.72 | 3.20 | NS |
| Ireland (92) | 2.2 (13) | –0.6 | –5.62 | 4.77 | NS |

*(continued)*

**Table 4 (continued)**

| Country (Starting Year) | SMR First 3 Years Average (Rank[a]) | % SMR Annual Change | 95% CI | | *p* Value |
|---|---|---|---|---|---|
| Portugal (93) | 1.0 (21) | –0.2 | –14.47 | 16.46 | NS |
| Belgium (88) | 1.5 (17) | –0.2 | –5.65 | 5.59 | NS |
| Slovakia (92) | 3.9 (6) | –0.1 | –4.18 | 4.10 | NS |
| Latvia (96) | 12.4 (2) | 0.1 | –8.63 | 9.68 | NS |
| United Kingdom (93) | 0.5 (23) | 0.7 | –1.90 | 3.44 | NS |
| Slovenia (92) | 2.8 (11) | 3.6 | –7.69 | 16.34 | NS |
| Greece (92) | 6.5 (4) | 4.2 | 1.01 | 7.38 | 0.03 |
| France (91) | 1.8 (16) | 4.2 | –1.11 | 9.80 | NS |
| Norway (92) | 2.5 (12) | 4.4 | –0.48 | 9.61 | NS |
| Finland (93) | 3.6 (7) | 5.8 | 2.13 | 9.61 | 0.01 |
| Sweden (92) | 1.9 (15) | 8.1 | 4.01 | 12.25 | 0.004 |
| EU-25 and EFTA | 2.0 | 0.2 | –2.11 | 2.55 | NS |

Source: WHO mortality database, last available decade (c. 1993-2002) adjusted by CEREPRI.
Note: Ranking of the regression-derived percentage annual change of the age-standardized mortality rate (SMR) per 100,000 person-years among elderly (65+ years), with 95% confidence intervals (95% CI) in EU-25 and EFTA countries excluding states with <1,000,000 inhabitants.
a. (1) = highest, (23) = lowest SMR.

countries, namely, Denmark, the Czech Republic, Austria, Hungary, Poland, United Kingdom, and Italy, whereas statistically significant increases were observed in France.

*Accidental drowning and submersion.* Last, Table 4 (Accidental drowning and submersion) shows that the average SMRs during the first 3 years of the study period for accidental drowning and submersion among the EU and EFTA countries range from ≤1 deaths (United Kingdom, the Netherlands, and Portugal) to >10 deaths per 100,000 person-years again in the three Baltic states, Estonia, Latvia, and Lithuania.

Substantial and statistically significant gains for the prevention of accidental drowning and submersion are seemingly noted (Table 4, Accidental drowning and submersion) in some countries, namely, Hungary, Italy, the Czech Republic, Lithuania, and Germany, whereas statistically significant increases are observed in three other EU member states (Sweden, Finland, and Greece). Because of the small numbers, and the change of the coding system in some countries during the study period, however, these results should be again interpreted with caution.

## Discussion

The overall and cause-specific pattern of unintentional age-standardized injury mortality among elderly people in this study shows a great variability across countries both at the beginning as well as at the end of the study period. The highest starting rates are observed, as expected, in eastern European countries, including Hungary, the Czech Republic, and Slovenia (Sethi, Racioppi, Baumgarten, & Bertollini, 2006), although unexpectedly high rates are noted in certain western EU countries including France, Denmark, and Finland. Almost half of the large proportion of the European Union area countries, however, seem to enjoy steady declining trends by major unintentional injury mortality category. The greatest gain was noted in countries with the highest mortality rates at the beginning of the study period. A statistically significant increase was observed in Latvia, whereas nonsignificant small increases were calculated for United Kingdom, Ireland, and Sweden. Specifically, rates from accidental falls were reduced by 4.3%, from motor vehicle traffic by 3.1%, and from smoke, fire, and flames also by 3.1%.

Falls among the elderly constitute the principal cause of death because of an injury. The rapidly increasing aging population in the EU is expected to further raise the burden and associated cost of fall-related injury and death (Kannus et al., 2005). The intercountry injury variability could be related to the prevalence of osteoporosis linked to climate and nutritional differences (Pasco et al., 2004; Rosen et al., 1994). Indeed, fall-related deaths appear to be lower in countries with favorable climate and/or more advanced health care and welfare systems. An important geographic variation in the occurrence of the major osteoporotic fractures across Europe is already well documented (Roy et al., 2002). However, it cannot be ruled out that part of cross-country differences might be because of the variation in the sources used for coding the cause of death among different countries, namely, death certificates, coroners' reports, or hospital discharge data in hospital deaths (Koehler et al., 2006; Langlois, Smith, Baker, & Langley, 1995). As in studies of other conditions, international comparisons of injury death rates based on underlying cause, especially in studies of the elderly, must consider variation between countries in death certification and different coding practices among physicians in assigning death to a specific cause (Langlois et al., 1995). However, it seems unlikely that substantial transfers between falls and other injury categories, because of diverse classification practices, could account for much of the wide variation in country-specific falls-related deaths. Deaths because of falls among elderly are considerably high; therefore, if a large number of falls-related deaths were misclassified to another cause, this would

have led to an implausible high mortality from other specified injuries given the observed rates.

A more likely source of variation is differences in coding with respect to the role of falls in conjunction with leading chronic causes of death at older ages. Falls among the elderly may occur in the context of an ongoing disease process that creates a condition of physical impairment, frailty, cognitive decline, or seizure that leads to the fall. A fall in turn may lead to a hospitalization that leads to a cascade of consequences such as the onset of dementia or loss of function in the hospital setting. There is some evidence from comparisons of hospital records and death certificates that underlying cause coding is ambiguous between accidents and nonaccidental causes at older ages (Koehler et al., 2006). Because falls are uncommon as underlying cause of death relative to, for example, cardiovascular causes or dementias, small differences in coding practices in different national settings might lead to large differences in rates at which falls are coded as the underlying cause.

Southern countries enjoy the lowest fall injury mortality rate. By contrast, several Southern EU-member states suffer a high road traffic mortality burden. The diverse pattern in death rates among the EU-25 countries because of road traffic accidents among the elderly may be associated with intercountry variation related to differences in the frequency of road traffic accidents to delayed activation of the trauma care system or low quality of prehospital and hospital care. It has been estimated that up to 40% of hospital deaths after road crashes could be avoided if all victims received appropriate treatment by qualified and trained personnel in well-coordinated and well-equipped departments (Haegi, 2002). The highest death rates because of road traffic accidents among Eastern European countries most likely reflect the deficits in legislation on alcohol-impaired driving, legislation governing quality of motor vehicles and seat belt use, and government expenditure on roads (Racioppi, Eriksson, Tingvall, & Villaveces, 2004). Studies in the United States suggest that enforcement of legislation regarding seatbelt use is of prime importance in the reduction of older driver fatalities (Morrisey & Grabowski, 2005). Pedestrian road deaths are of particular concern in the elderly group; persons older than 60 are more than four times as likely to die when injured by a car in comparison to younger people (Sklar, Demarest, & McFeeley, 1989). In addition, poor road infrastructure, lack of footpaths, and differences in road lighting may account for the differences seen between countries.

Rapid societal changes, such as in Eastern Europe, might be associated with the increased mortality rates among the three Baltic countries at the beginning of the study period (Cornia & Paniccià, 2000). Unemployment, discrimination, social disintegration, redistribution of wealth in fewer hands

combined with high levels of poverty have led to changes in exposure to risk, a weakening of the safety and support networks that diminish the effects of injuries (Sethi et al., 2006). Risk taking and unhealthy behavior among the elderly may be partly explained as a way of dealing with distress created by the demands of a transition society (Kaasik, Andersson, & Horte, 1998). As an example, alcohol consumption and in particular binge drinking may be one of the causes of increased deaths because of accidental poisoning among the elderly in Lithuania and Estonia in the early 1990s (Leinsalu, Vagero, & Kunst, 2004). In a similar way, death because of accidental drowning in the Baltic countries may be attributed to alcohol consumption. Furthermore, the high proportion of smokers along with the poor housing infrastructure may account for the high burden of smoke, fire, and flames deaths observed in the respective countries.

Concerns have been expressed with regard to intercountry comparisons, as unintentional injury-related figures might underestimate the true size of the problem. Death certification is likely to be somewhat inaccurate because of different coding practices of injury deaths among the EU countries (Moyer, Boyle, & Pollock, 1989; Stalioraityte, Pangonyte, & Kazlauskaite, 2005). Classification differences are possible because of diverse interpretation of the coding rules by the various member states. In addition, the countries vary on the sources of information on which classification of the causes of deaths are based (Fingerhut, Cox, & Warner, 1998). Moreover, estimates of specific causes of injury-related mortality may be underestimated or overestimated because of attribution of death to other external causes. A study of drowning fatalities in New Zealand found that deaths because of drowning were frequently assigned to other external causes such as motor vehicle crashes, and the authors conclude that a similar pattern might exist in other countries (Smith & Langley, 1998).

It is worth noting that mortality rates depend on the incidence of injuries among the elderly on one hand and on the case fatality ratio on the other. Both components may significantly diverge among the EU countries, and therefore, they might contribute to the observed variation of the reported injury mortality rates. Finally, cause-specific mortality trends can be affected by a variety of reasons including changes between ICD9 and ICD10 coding versions applied during the study period. Changes in definitions of causes of death and the practice of medical certifiers in attributing deaths to these causes may be additional contributing factors. The World Health Organization and several EU countries have been involved in the International Collaborative Effort (ICE) on Injury Statistics (Fingerhut, 2004). The shared vision of this effort is the improvement of injury statistics to make them internationally comparable and of the highest quality. It is unlikely, however, that the wide

variations observed in most of the injury types explored in this study can be explained by the above-mentioned factors (Stone et al., 2006).

The results of this study can be appreciated provided that formulation of public health decisions should be based on valid and updated information. We recognize that further epidemiological studies are needed to confirm the ecological associations noted in this study and explore the underlying pathogenetic processes. Nevertheless, it is evident that some countries with documented injury prevention records and ethos present low fatality rates for most types of injuries and consistently declining time trends (Petridou et al., 2006). Thus, policy lessons and preventive programs established in low mortality countries could operate as good practices initiatives for less privileged countries with high injury mortality rates.

The conclusions drawn regarding the evolution of injury mortality within EU member states may be used by policy makers, injury practitioners, and stakeholders in different countries with similar sociodemographic and geographical conditions in determining appropriate good practices interventions. This may be an important issue in view of the European Union–wide injury prevention campaigns envisioned in the European Commission and Parliament Communications (Commission of the European Communities, 2006). Moreover, the Regional Committee declaration on the prevention of injuries (WHO Regional Committee for Europe Resolution EUR/RC55/R9 on prevention of injuries in the WHO European Region, 2005) provides a framework for public health action to control unintentional injuries and violence. These initiatives highlight injuries as a public health right of way and provide a policy podium from which a more systematic and coordinated tactic to injury prevention can be established.

In conclusion, a large proportion of the European Union area countries seem to enjoy steady declining trends by major unintentional injury mortality category. Success factors and barriers underlying these benchmarking patterns should be further explored to speed up the process for a uniform reduction of injuries across this part of the world.

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