



Unintentional Fall-Related Mortality among the Elderly in Serbia: Importance of Death Reporting Quality

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Abstract

Background: Falls have been one of the leading causes of injury-related deaths among the elderly, having an increasing trend in many countries. We investigated trends of fall-related mortality among people aged ≥ 65 yr in Serbia.

Methods: Based on official data, we calculated unintentional fall-related mortality rate (MR) from 1998 to 2017, using join point regression analysis to determine annual percentage changes (APC). Starting from 2005, doctors from Serbian Public Health Institute have been controlling the quality of death certificates.

Results: In the 1998-2004 period, MR decreased in men and women aged 65-74 and men aged ≥ 85 (by -12.4; -13.0; and -15.1% yearly) followed by an upward trend in men and women aged 65-74 (by 76.3 vs.40.2%/yearly) from 2004 to 2007 and men aged ≥ 85 (by 13.7% yearly) from 2004 to 2017. MR decreased among women aged ≥ 85 (by -9.8% yearly) from 1998 to 2008 and then increased (by 9.0% yearly) from 2008 to 2017. In men and women aged 75-84, an increase of MR (by 7.4 vs.3.1%) was observed during the entire study period. In all age groups, except women aged ≥ 85 , significant negative correlation was found between fall-related deaths and ill-defined and unknown causes of deaths.

Conclusion: Control of death certificates by physicians from the Institute of Public Health led to the better reporting of the increasing trend of fall-related mortality among the elderly. Policy makers must investigate risk factors for fall and then adopt national guidelines for prevention and treatment of fall-related injury.

Keywords: Falls; Elderly; Mortality; Serbia

Introduction

More than a third of elderly falls at least once every year, while for one-half of them the fall is repeated (1). Bruises, lacerations, dislocations, twists, hematoma, pain, decrease of function and

loss of independence, loss of self-efficacy and fatal outcome often occur because of falls among the elderly (2). Hospitalizations, emergency interventions and other treatments, such as rehabilita-



tion from fall-related injuries, significantly increase the expenses and the workload of healthcare services (3).

Globally, falls are the leading cause of unintentional injury deaths among persons aged ≥ 70 yr with rise of mortality rate by 41.6% yearly in the 2007-2017 period (4). In the European Union, every year about 1.4 million of people aged ≥ 65 yr are admitted to hospital for treatment of fall-related injuries and nearly 36,000 dies from fall (5). In 2019, over one fifth of the population (20%) of the European Union consisted of persons aged ≥ 65 yr and that number is projected to increase to 29% in 2050 (6). Over the coming years, in line with the aging population in Europe, it is expected that fall-related deaths would rise to almost 60,000 by 2050 (5).

The increasing trend of fall related mortality rate among the elderly was registered in the USA (7) in all age groups of the elderly, in Spain (8) in men aged ≥ 65 yr as well as in women aged ≥ 75 yr while in the Netherlands (9), the increase in all age groups of the elderly is not significant. On the contrary, in Japan (10), in the 65-74 age group, the mortality from unintentional falls has been decreasing for both genders, as well as in women older than 75 years.

A recent study conducted in 22 Western European countries, reported a significant variation in fall-related mortality rates among people older than 70 yr (11). Similarly, variation in the mortality rate due to unintentional falls among the elderly (2010-2012) was observed in the EU countries - from 134 in Hungary to 0.28 per 100,000 elderly people in Cyprus. The reason is different methodology in death reporting between the countries (underlying cause of death is often left unreported) (5).

Hu and Baker showed that improvement in death reporting influenced the values of fall-related mortality rate among the elderly (12). Usually, the proportion of certified deaths due to ill-defined and unknown conditions may be used as an indicator of improper death certification (13). High quality death certification data are essential for well-designed public health policy and prevention of premature death (14).

Apart from the quality of death reporting, fall-related mortality rate among the elderly is influenced by many other factors such as the incidence of falls, fall-related injury severity and the prevalence of fragility (8). However, results of a study conducted in 195 countries showed that the countries with the highest incidence of fall-related injury do not necessarily have the highest cause-specific mortality. Authors concluded that mortality of falls are probably influenced by care access and fall severity (15).

Furthermore, the probability for occurrence of fatal fall is increasing with the increasing age of life in both, men and women (16). At the same time, it is expected that the share of people aged ≥ 65 years in the total population of Serbia, will increase from 17% in 2011 to 33% in 2061 (17). Changes in the methodology of death reporting in the Republic of Serbia began in 2005. There is no national data about the incidence rate and mortality rate due to unintentional falls among the Serbian elderly.

Taking into account the increase in the Serbian elderly population, the primary aim of this study was to establish trend of unintentional fall-related mortality in the elderly population of Serbia.

Additionally, available data indicated that the methodology for reporting deaths may affects the values of the fall-related mortality rate. For this reason, we aimed to investigate the influence of the changes in death reporting methodology of the fall related-mortality in the Serbian elderly.

Materials and Methods

Study design and procedures

Information on the number of the Serbian elderly who died from unintentional falls, in the 1998-2017 period, were sourced from the Statistical Office of the Republic of Serbia.

During the study period, all deaths were registered by completed death file (certificate of death and statistical form for reporting deaths- DEM-2) (18, 19). The certificate of death is issued by authorized doctor, a forensic doctor or a coroner and then it is handed over to the registry office,

which registers the deceased in the registry of deaths. Until 2005, death files were forwarded to the Regional Statistical Offices where death certificates were controlled and from where they were sent for control to the Statistical Office of the Republic of Serbia.

According to the new legal regulation from Jan 2005, from Regional Statistical Offices, the death certificate together with the DEM 2 form was sent to regional Institutes of Public Health. The certified physicians in the Institutes, control the death certificate data, code the underlying cause of death from the death certificate, and enter into Form DEM-2. If there are any ambiguities in the death file, the physician who completed death file is contacted in order to clarify the ambiguities and certificate of death is corrected. The Institutes submit the consolidated summary reports in electronic form to the Institute of Public Health of Serbia, and in the regional statistics department, from where they are forwarded to the Statistical Office of the Republic of Serbia (18).

Rulebook on the procedure of issuance and the form of the death certificate was changed in 2011 and 2018, but the procedure itself was not changed significantly (19). All the data files are confidential and considered officially undisclosed information.

Fall-related death certificates were coded by International Classification of Diseases-10th Revision (ICD-10) as external causes of mortality (W00-W19). The circumstances of fall were grouped as a fall on the same level (W00-W01; W18), unspecified fall (W19) and other falls (W02-W17).

To assess the influence of control of death certificates by Public Health Institutes, on the improvement of mortality statistics among the elderly, we extracted the data on mortality due to ill-defined and unknown causes of death marked with an R-code (ICD-10: R00 -R99).

The age-group specific mortality rate (MR) was expressed as a number of deaths per 100,000 persons older than 65 yr, and presented by age group (from 65 to 74 yr, 75 to 84 yr and ≥ 85 yr) and gender.

The information on the Serbian elderly population was derived from the censuses data in 2002 and 2011 and for inter-census yr, the estimates of the elderly population according to age group were obtained from the Statistical Office of the Republic of Serbia (20).

Statistical analysis

Categorical variables are reported as numbers, frequencies (%) and average annual mortality rate (MR) with corresponding 95% confidence intervals (95%CI).

Spearman's correlation coefficient (Spearman's ρ) was calculated to describe correlations between fall-related mortality (ICD-10- W00-W19) and ill-defined and unknown causes of deaths (ICD-10- R00-R99). *P*- Values < 0.05 were considered statistically significant.

Trends of fall-related mortality rate were assessed using the Join point Regression Program version 4.2.0.7. (Statistical Methodology and Applications Branch, Surveillance Research Program, US National Cancer Institute). The dependent variable was the mortality rate, whereas the independent variable was calendar year. The best-fitting log-linear regression model assuming a Poisson distribution was performed, to determine calendar years (joinpoints) when fall related mortality rate changed significantly (*P*- value < 0.05). Join point regression determines the optimal number of join points, using a Monte Carlo permutation method. Changes in fall related mortality rate were presented as the annual percentage change (APC) with corresponding 95% confidence intervals in each segment (21).

Results

To investigate the trends and patterns of unintentional mortality related fall, we identified 5,228 cases of fall-related deaths in Serbia in the 1998-2017 period. Based on the methodology defined in our study, the final research included 3,646 elderly people who died due to unintentional falls.

Table 1 shows demographic characteristics of the study participants. Average annual MR due to unintentional fall was 1.5-fold greater in men compared to women. Men aged ≥ 85 had more than four-time higher MR than men aged 65-74. Similar situation was also seen in women where

MR for women aged ≥ 85 was twelve times higher than for women aged 65-74. The most common circumstances of deaths were due to unspecified fall. The greatest MR of fall-related injuries with fatal outcome occurred at home (Table 1).

Table 1: Numbers (n) of elderly who died due to unintentional fall and fall-related mortality rates (MR) per 100,000 elderly persons in Serbia, according to gender, age group, place, and circumstances of falls, 1998-2017

Variables	Total			Men			Women		
	n	%	MR (95%CI)	n	%	MR (95%CI)	n	%	MR (95%CI)
Age group (yr)									
65-74	1125	30.9	7.4 (6.1 to 8.7)	758	39.4	11.3 (9.0 to 13.5)	367	21.3	4.3 (3.7 to 5.0)
75-84	1754	48.1	20.5 (17.3 to 23.8)	875	45.4	25.3 (20.4 to 30.2)	879	51.1	17.3 (14.9 to 19.7)
≥ 85	767	21.0	50.8 (43.1 to 58.6)	293	15.2	49.9 (38.3 to 61.4)	474	27.6	51.4 (42.2 to 60.7)
Total	3646	100	14.3 (11.9 to 16.7)	1926	52.8	17.8 (14.1 to 21.5)	1720	47.2	11.7 (10.0 to 13.4)
Place of fall									
At home	2331	63.9	9.1 (7.0 to 11.2)	1191	61.8	11.0 (8.3 to 13.7)	1140	66.3	7.7 (6.1 to 9.4)
Out of home	1315	36.1	5.2 (4.2 to 6.1)	735	38.2	6.8 (5.4 to 8.2)	580	33.7	4.0 (3.0 to 5.0)
Circumstances of falls									
Fall on the same level	1086	29.8	4.2 (2.5 to 5.9)	534	27.7	4.9 (3.0 to 6.8)	552	32.1	3.7 (2.1 to 5.3)
Unspecified fall	1542	42.3	6.1 (5.4 to 6.8)	699	36.3	6.5 (5.8 to 7.2)	843	49.0	5.8 (4.8 to 6.9)
Other falls	1018	27.9	4.0 (2.9 to 5.0)	693	36.0	6.4 (4.8 to 8.0)	325	18.9	2.2 (1.5 to 2.9)

In men and women aged 75-84, a significant increase in MR was observed during the entire study period. MR significantly decreased in men and women aged 65-74, men aged ≥ 85 from 1998 to 2004 and women aged ≥ 85 from 1998 to 2008. However, MR increased in men and women aged 65-74 (although in women it increased insignificantly) from 2004 to 2007 and in men aged ≥ 85 from 2004 to 2017. During the last ten

years of study period (2007-2017), in men and women aged 65-74, MRs do not change significantly. In women aged ≥ 85 , MR significantly increased from 2008 to 2017.

Overall, among persons aged ≥ 65 , we initially observed a significant annual decrease of MR, followed by a non-significant increase from 2004 to 2007 and finally we recorded a significant rise of MR in the 2007-2017 period (Table 2).

Table 2: Annual average percent change (APC) of age-group specific mortality rate (MR) due to unintentional falls among males and females ≥65 yr old in Serbia, 1998-2017

Age group (years)	Gender	MR 1998-2017	1st period trend			2nd period trend			3rd period trend		
			Period	APC (95%CI)	P-value	Period	APC (95%CI)	P-value	Period	APC (95%CI)	P-value
65-74	Men	7.4	1998	-12.4	<0.005	2004	76.3	<0.005	2007	-2.7	0.079
			2004	(-18.1 to -6.4)		2007	(18.9 to 161.4)		2017	(-5.6 to 0.4)	
	Women	3.8	1998	-13.0	0.006	2004	40.2	0.207	2007	0.9	0.666
			2004	(-20.8 to -4.5)		2007	(-19.3 to 143.4)		2017	(-3.4 to 5.3)	
75-84	Men	14.3	1998	7.4	<0.001						
			2017	(4.1 to 10.8)							
	Women	15.8	1998	3.1	0.021						
			2017	(0.5 to 5.8)							
Men	66.1	1998	-15.1	0.020	2004	13.7	<0.001				
		2004	(-25.8 to -2.9)		2017	(9.0 to 18.5)					
≥85	Women	70.5	1998	-9.8	0.006	2008	9.0	0.038			
			2008	(-15.8 to -3.4)		2017	(0.5 to 18.1)				
≥65	All	10.6	1998	-10.6	<0.001	2004	34.9	0.060	2007	4.1	0.004
			2004	(-15.2 to -5.7)		2007	(-1.5 to 84.8)		2017	(1.6 to 6.7)	

Over the study period, MR due to ill-defined and unknown causes of deaths showed a decreasing trend, from 432.5 in 1998 to 284.2 per 100,000 in 2017 among men and from 357.8 in 1998 to

248.8 in 2017 among women. Drastic downward trend was observed in the 2004-2007 period for both genders (Fig. 1).

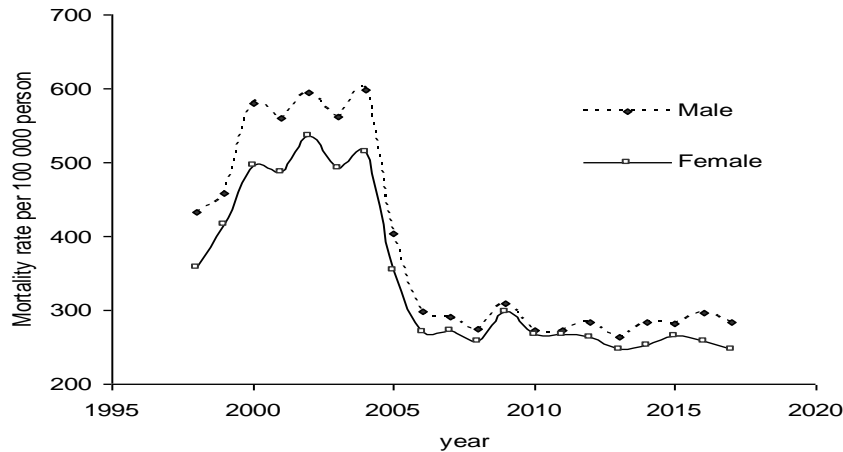


Fig. 1: Trend of mortality rate due to ill-defined and unknown causes of deaths (R00-R99) among elderly aged ≥65 yr in Serbia, 1998-2017

Significant negative correlation between unintentional fall-related mortality and ill-defined and unknown causes of death rate was observed among all age groups of men as well as women aged 65-74 and aged 75- 84 years. Only among

females aged ≥85 a non-significant positive correlation was recorded (Table 3). In all age groups of the elderly (with exception of women aged ≥85), when mortality rate of ill-defined and unknown causes of mortality was decreasing, fall related mortality rate was rising.

Table 3: Spearman correlation coefficients (Spearman's ρ) between unintentional fall-related mortality rate and ill-defined and unknown causes of mortality rate among the elderly aged ≥ 65 years in Serbia

<i>Age group (yr)</i>	<i>Men</i>		<i>Women</i>		<i>All</i>	
	Rho	<i>P</i> -value	Rho	<i>P</i> -value	Rho	<i>P</i> -value
65-74	-0.731	<0.001	-0.743	<0.001	-0.744	<0.001
75-84	-0.756	<0.001	-0.595	0.006	-0.795	<0.001
≥ 85	-0.595	0.006	0.286	0.222*	0.124	0.602*
≥ 65	-0.815	<0.001	-0.660	0.001	-0.800	<0.001

**P*-value >0.05 - not statistically significant

Discussion

Differences in the death coding practice have a significant impact on the mortality rate caused by the fall. Thus, in some EU countries, unintentional fall may be recorded as a cause of death while in other countries the consequences of fall may be reported as a cause of death (e.g., pneumonia) (22). In the USA, previous cardiovascular diseases, as well as pneumonia caused by the lack of mobility after the fall, are often reported as an underlying cause of fall-related death (23).

Death certificates completed by doctors may also underestimate the contribution of the injury to the elderly mortality (24) and that among the elderly, deaths due to injury may be underestimated by as much as 50% overall (25).

On the other hand, two studies conducted among the elderly in the USA found that changes in the process of death reporting led to an increase in mortality from injuries (26) and that better reporting quality contributed to the increased unintentional fall mortality (27).

This was confirmed in our study, which showed a decreasing trend in fall-related mortality among the elderly aged ≥ 65 yr in the 1998-2004 period, followed by a growth trend after 2004. The implementation of better control and verification of death certificates by physicians of the network of Public health Institutes is most probably responsible for this phenomenon.

This claim is supported by the fact that, the trend of mortality rate due to ill-defined and unknown causes of deaths decreased in Serbia after 2004.

Prior to the legal changes in death reporting in 2005, there were two weaknesses in the mortality data in Serbia - misclassification of the cause of death or attribution of some other ill-defined code (28). Misclassification or recording of the cause of death as unspecified unintentional injury influences the rate of fall-related mortality (29).

We found a negative correlation between fall-related mortality and ill-defined and unknown causes of mortality in all age groups of both genders excluding women aged ≥ 85 yr. This fact can also be explained by better control of death reporting. However, it is necessary to examine what other factors have led to an increase in mortality from unintentional fall, especially among women aged ≥ 85 yr.

In general, unintentional fall-related mortality rate among the elderly in the current study, as well as in most of the other countries is higher for males. Many authors have explained this phenomenon by the generally poorer health condition of men and by the existence of a higher number of comorbidities among them (16).

Present results showed also that men have higher fall-related mortality rates in all age groups, with the exception of those aged 85 or older where the rates are at approximately the same level (49.9 vs. 51.4 per 100, 000). Overall, in Serbia the total mortality rate is higher in males in all age groups of Serbian population, excluding the people older than 85 yr where rates were almost the same (199.9 per vs. 190.0 per 100, 000 in 2017) (30).

In this study, two thirds of fatal falls occurred in home settings. Most often, the elderly people

with poor health status have limited living space and spend a lot of time at home, so it is far more likely that the fall will occur in their homes or around them. The latest data from a national survey conducted in Serbia showed that three quarters of the elderly citizens of Serbia (75.8%) stated that they had a long-term illness or health problem. Thus, in Serbia every third elderly person (37.1%) stated that they have problem walking. Moreover, two thirds (66.3%) of people aged 85 or older had problem walking (31).

Furthermore, in more than 40% deaths due to fall, the circumstances of the fall are marked as unspecified. At the same time, the data showed that 4/5 of single occupant homes in Serbia comprise of persons aged ≥ 60 yr (32). In these cases, the witness of the fall doesn't exist and the improvement in death reporting cannot affect this data.

Study limitation. In this study, we did not have data on the health status of the elderly who experienced falls, which significantly affects the final health outcome of the fall. In British Columbia, after policy change, an increasing trend in fall-related mortality was noted. However, among person aged ≥ 80 yr, this was followed by an increase in natural deaths with fall as the contributing cause (33).

In Addition, many physicians in Serbia as a cause of death report just the early but not late complications, which had been caused by the fall because they lack the information about the fall itself. However, introduction of the electronic health-information system in Serbia should make these data available.

Yet, this study does not include the data for the last 3 years, so results of this study are not up-to-date, and caution in using the results of this study is needed.

Conclusion

After changes in the processing and control of mortality data, unintentional fall-related mortality in Serbia, in people ≥ 65 yr showed an increasing trend. It is obvious that the control by the Institute of Public Health prevented the underestima-

tion of the death rate from falls in the Serbian elderly.

Before beginning to design of the national fall prevention program, health policy makers and other stakeholders must examine which factors (poor health status of the elderly, changes in health care, etc.) have led to the increase in fall-related mortality among the Serbian elderly.

A prompt implementation of fall prevention intervention among the elderly population as well as early diagnosis, treatment and rehabilitation of the injuries caused by the fall will contribute to the reduction of the fall-related mortality.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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