

Table 1. Deaths of older people per 100,000 older people's population and their average yearly percentage change over the period 1997-2006 (PIN Flash 9 Fig. 1)

Country	Older people's deaths per 100,000 older people's population / Year											Average yearly % change in road mortality of older people over the period 1997-2006 ^(**)
	1996 ^(*)	1997 ^(*)	1998 ^(*)	1999	2000	2001	2002	2003	2004	2005	2006	
Portugal	28.20	25.12	24.06	21.31	20.85	19.17	17.61	17.34	12.94	12.42	11.90	-8.12
Israel	23.38	20.50	20.74	18.15	14.79	15.22	15.76	12.38	13.02	12.07	11.90	-7.17
Malta ^(†)	9.52	6.91	6.75	11.04	4.35	14.51	16.09	7.85	1.92	5.60	1.84	-6.76
France	16.32	15.39	16.13	14.48	13.28	13.30	12.90	10.49	8.97	9.81	8.83	-6.21
Cyprus	34.48	29.79	33.31	35.52	24.53	25.41	20.67	26.02	28.77	14.54	18.41	-6.01
Denmark	16.22	16.65	15.54	14.80	16.95	12.88	13.09	12.40	9.94	8.62	8.75	-5.96
Slovenia	22.32	20.96	21.22	24.33	19.90	15.94	15.95	17.66	15.99	13.10	10.32	-5.62
Greece	25.84	22.98	25.00	22.94	23.14	20.59	17.36	16.22	15.50	15.62	15.51	-5.55
Switzerland	15.13	12.98	14.15	12.32	14.80	11.45	9.37	10.94	10.55	9.20	8.47	-4.96
Norway	11.23	10.38	11.71	9.59	8.93	9.87	7.10	7.72	8.01	6.20	9.52	-4.84
Slovakia							14.04	12.98	12.90	9.59	13.28	-4.82
Finland	13.73	16.35	13.71	12.51	13.64	12.19	12.40	11.81	11.67	10.82	8.17	-4.31
The Netherlands	13.25	12.76	10.76	11.36	10.92	10.21	9.73	9.95	8.88	8.21	9.01	-4.11
Spain	13.90	14.23	13.80	13.79	12.57	12.63	11.94	11.51	10.33	9.86	9.13	-3.94
UK	8.48	8.46	8.33	8.17	7.31	6.98	6.77	6.94	6.18	6.41	5.90	-3.80
Germany	10.60	10.74	10.24	9.99	9.82	9.37	8.79	9.20	8.08	7.56	7.27	-3.56
Sweden	10.82	9.59	8.10	9.76	8.94	8.56	7.90	7.69	9.02	6.69	6.07	-3.49
Hungary	18.21	18.63	16.07	15.94	13.83	16.05	14.88	14.88	13.66	13.06	13.58	-3.38
Czech Republic	20.19	18.37	16.83	15.52	17.14	16.87	14.99	16.29	17.36	14.08	11.88	-3.23
Ireland	14.01	15.61	19.03	19.44	12.71	10.94	13.76	11.97	13.53	12.16	14.10	-3.21
Poland	21.83	24.10	23.75	23.05	19.26	20.00	20.32	17.87	19.23	18.34	18.11	-3.06
Austria	28.20	25.12	24.06	21.31	20.85	19.17	17.61	17.34	12.94	12.42	11.90	-3.00
Belgium	16.42	14.34	15.49	13.73	13.88	15.26	12.31	13.62	11.29	10.34	10.67	-2.64
Estonia	13.18	12.95	13.31	9.80	10.66	11.00	10.81	10.61	17.68	6.70	13.65	-2.48
Italy	13.86	14.64	12.82	13.71	13.94	13.04	13.71	12.65	11.62	10.54	10.52	-2.27
Bulgaria					16.76	15.65	12.80	13.77	12.90	15.63	13.85	-1.94
Latvia	18.24	20.03	18.31	19.06	17.83	14.99	14.29	18.67	21.31	16.00	16.34	-1.50
Luxembourg ^(†)	5.17	15.19	11.63	11.46	16.15	13.13	14.53	9.54	20.42	10.79	3.03	-1.28
Romania				13.75	13.87	14.00	15.05	13.50	15.38	15.46	15.76	2.01
Lithuania ^(†)									21.63	19.73	23.38	N/A
EU (22) average ⁽²⁾	14.31	14.33	13.85	13.54	12.76	12.40	12.02	11.44	10.54	9.95	10.24	-3.74
PIN (25) average ⁽³⁾	14.38	14.34	13.90	13.53	12.78	12.40	11.98	11.41	10.54	9.93	9.57	-4.01

(^{*}) For the estimation of the average annual reduction, the mean value of the years 1996, 1997, 1998 was used as baseline dated 1997 instead of using the single value registered in 1997. Except: Slovakia (2002, 2003, 2004), Bulgaria (2000, 2001, 2002) and Romania (1999, 2000, 2001).

(^{**}) Slovakia 2003-2006, Bulgaria 2001-2006, Romania 2000-2006

([†]) Luxembourg and Malta are excluded from Fig.1 because the annual numbers of deaths in those countries are below 20 and thus subject to substantial random fluctuation. The estimation is not available for Lithuania due to a too short timeline (number of elderly deaths is available only for

(²) EU (27) excluding Bulgaria, Lithuania, Malta, Romania and Slovakia

(³) PIN (30) excluding Bulgaria, Lithuania, Malta, Romania and Slovakia

Table 2. Road mortality rate of older people with the road mortality rate of the rest of the population (0-64)
(PIN Flash 9 Fig. 2)

Country	Deaths of elderly people aged 65 or over per 100.000 elderly population aged 65 or over / Year				Deaths of population aged 0-64 per 100.000 population aged 0-64 / Year			
	2004	2005	2006	Average 2004-2006	2004	2005	2006	Average 2004-2006
Malta	1.92	5.60	1.84	3.12	3.45	4.01	2.86	3.44
UK	6.18	6.41	5.90	6.16	5.54	5.39	5.41	5.45
Sweden	9.02	6.69	6.07	7.25	4.59	4.51	4.68	4.59
Germany	8.08	7.56	7.27	7.63	6.86	6.25	5.91	6.34
Norway	8.01	6.20	9.52	7.91	5.20	4.63	4.47	4.77
The Netherlands	8.88	8.21	9.01	8.70	4.31	4.01	3.71	4.01
Denmark	9.94	8.62	8.75	9.10	6.29	5.68	5.08	5.68
France	8.97	9.81	8.83	9.20	8.89	8.25	7.21	8.11
Switzerland	10.55	9.20	8.47	9.39	6.25	4.82	4.29	5.12
Spain	10.33	9.86	9.13	9.77	11.39	10.41	9.43	10.40
Finland	11.67	10.82	8.17	10.19	6.31	6.52	6.01	6.28
Belgium	11.29	10.34	10.67	10.76	11.15	10.44	10.07	10.55
Italy	11.62	10.54	10.52	10.89	10.33	9.81	9.43	9.86
Luxembourg	20.42	10.79	3.03	11.31	9.28	10.00	8.43	9.23
Slovakia	12.90	9.59	13.28	11.92	10.98	10.50	10.40	10.62
Israel	13.02	12.07	11.90	12.32	6.33	5.79	5.16	5.75
Austria	14.16	11.51	11.46	12.34	10.17	8.95	8.31	9.14
Portugal	12.94	12.42	11.90	12.42	12.23	11.73	8.60	10.85
Estonia	17.68	6.70	13.65	12.66	11.59	13.70	15.48	13.58
Slovenia	15.99	13.10	10.32	13.10	13.30	12.78	13.54	13.21
Ireland	13.53	12.16	14.10	13.27	8.71	9.26	7.93	8.63
Hungary	13.66	13.06	13.58	13.43	12.66	12.58	12.81	12.68
Bulgaria	12.90	15.63	13.85	14.12	11.92	11.65	13.44	12.33
Czech Republic	17.36	14.08	11.88	14.42	12.91	12.34	10.12	11.79
Romania	15.38	15.46	15.76	15.54	10.57	11.53	11.24	11.11
Greece	15.50	15.62	15.51	15.55	15.04	14.81	14.75	14.87
Latvia	21.31	16.00	16.34	17.86	22.43	19.79	18.02	20.09
Poland	19.23	18.34	18.11	18.71	14.29	13.62	13.07	13.66
Cyprus	28.77	14.54	18.41	20.47	14.30	13.49	10.24	12.64
Lithuania	21.63	19.73	23.38	21.58	21.86	23.07	22.14	22.36
EU (27) average	10.86	10.33	9.99	10.39	9.47	9.01	8.48	8.98
PIN (30) average	10.85	10.29	9.98	10.37	9.31	8.86	8.33	8.83

Sources: National data provided by PIN panelists and CARE for number of deaths; Eurostat for population figures

Table 3. Ratio road mortality of older people / road mortality of the rest of the population (0-64)
(PIN Flash 9 Fig. 3)

Country	Ratio road mortality of older people / road mortality of the rest of the population (0-64)			
	2004	2005	2006	Average 2004-2006
Latvia	0.95	0.81	0.91	0.89
Malta	0.56	1.40	0.64	0.91
Estonia	1.53	0.49	0.88	0.93
Spain	0.91	0.95	0.97	0.94
Lithuania	0.99	0.86	1.06	0.97
Slovenia	1.20	1.03	0.76	0.99
Belgium	1.01	0.99	1.06	1.02
Greece	1.03	1.05	1.05	1.05
Hungary	1.08	1.04	1.06	1.06
Italy	1.13	1.07	1.12	1.10
Slovakia	1.17	0.91	1.28	1.12
UK	1.12	1.19	1.09	1.13
France	1.01	1.19	1.22	1.13
Portugal	1.06	1.06	1.38	1.14
Bulgaria	1.08	1.34	1.03	1.15
Germany	1.18	1.21	1.23	1.20
Czech Republic	1.34	1.14	1.17	1.22
Luxembourg	2.20	1.08	0.36	1.23
Austria	1.39	1.29	1.38	1.35
Poland	1.35	1.35	1.39	1.37
Romania	1.46	1.34	1.40	1.40
Ireland	1.55	1.31	1.78	1.54
Sweden	1.97	1.48	1.30	1.58
Denmark	1.58	1.52	1.72	1.60
Cyprus	2.01	1.08	1.80	1.62
Finland	1.85	1.66	1.36	1.62
Norway	1.54	1.34	2.13	1.66
Switzerland	1.69	1.91	1.97	1.84
Israel	2.06	2.08	2.31	2.14
The Netherlands	2.06	2.05	2.43	2.17
EU (27) average	1.15	1.15	1.18	1.16
PIN (30) average	1.17	1.16	1.20	1.17

Sources: National data provided by PIN panelists and CARE for number of deaths; Eurostat for population figures

Table 4. Expected percentage proportion of older people's deaths among all road deaths in the EU27 according to forecast population

(PIN Flash 9 Fig. 4)

Year	Population 65+	Population 0-64	SUM	Share	Deaths 65+	Deaths 0-64	SUM	Share	Share in %
2004-2006	81,177,782	409,598,844	490,776,626	0.165					
2005	81,046,436	406,834,477	487,880,913	0.166	8,438	36,510	44,948	0.188	18.8
2010	86,084,004	406,753,670	492,837,674	0.175	8,963	36,503	45,465	0.197	19.7
2020	102,015,931	394,392,520	496,408,451	0.206	10,622	35,393	46,015	0.231	23.1
2030	121,244,423	373,539,748	494,784,171	0.245	12,624	33,522	46,146	0.274	27.4
2040	137,018,681	349,973,236	486,991,917	0.281	14,266	31,407	45,673	0.312	31.2
2050	141,312,931	330,737,304	472,050,235	0.299	14,713	29,681	44,394	0.331	33.1

Mortality rates considered: 10.41 (65+) and 8.97 (0-64)

Sources: National data provided by PIN panelists and CARE for number of deaths; Eurostat for population figures

Table 5. Expected effect of population ageing on annual number of road deaths in 2020

(PIN Flash 9 Fig. 5)

Country	Older people (65+)					Rest of population (0-64)					Expected impact in %
	2004-2006			2020		2004-2006			2020		
	Deaths	Population	Mortality	Population	Deaths	Deaths	Population	Mortality	Population	Deaths	
Malta	2	53,357	3.12	88,253	3	12	348,936	3.44	365,767	13	-0.57
Latvia	68	380,731	17.86	388,383	69	387	1,926,011	20.09	1,727,043	347	-0.21
Spain	706	7,226,885	9.77	9,027,131	882	3,726	35,820,324	10.40	36,531,482	3,800	-0.19
Estonia	28	223,793	12.66	232,809	29	153	1,123,961	13.58	1,014,963	134	-0.14
Lithuania	112	518,917	21.58	557,932	120	650	2,905,905	22.37	2,624,283	587	-0.08
Slovenia	41	3,129,963	13.10	410,715	54	223	1,690,779	13.21	1,605,975	212	-0.04
Belgium	193	1,796,212	10.76	2,216,773	239	913	8,655,006	10.55	8,573,248	905	0.01
Greece	322	2,012,388	16.00	2,412,976	386	1,345	9,070,472	14.83	9,014,067	1,337	0.23
Hungary	212	1,578,467	13.43	1,971,596	265	1,080	8,518,490	12.68	7,721,686	979	0.28
Italy	1,237	11,366,719	10.88	13,608,121	1,481	4,632	47,000,725	9.86	44,691,551	4,404	0.40
UK	592	9,587,621	6.18	12,258,320	757	2,743	50,352,255	5.45	50,671,545	2,760	0.46
Portugal	222	1,787,345	12.42	2,191,608	272	948	8,737,166	10.85	8,579,153	931	0.47
Luxembourg	7	64,843	11.31	85,794	10	36	393,724	9.23	435,062	40	0.51
Slovakia	75	626,297	11.92	861,409	103	506	4,762,916	10.62	4,409,225	468	0.57
France	931	10,117,258	9.20	13,139,331	1,209	4,255	52,431,938	8.11	50,431,961	4,092	0.59
Bulgaria	188	1,331,009	14.12	1,475,135	208	793	6,429,349	12.33	5,320,917	656	0.65
Germany	1,172	15,365,840	7.63	18,668,830	1,424	4,259	67,124,332	6.34	64,007,630	4,061	0.78
Romania	492	3,168,712	15.53	3,472,390	539	2,055	18,491,286	11.11	16,869,769	1,875	0.92
Austria	162	1,312,676	12.34	1,690,218	209	630	6,891,514	9.14	6,750,875	617	1.33
Czech Republic	207	1,438,071	14.42	2,059,003	297	1,036	8,789,633	11.79	7,842,845	925	1.45
Ireland	60	459,842	12.98	700,497	91	319	3,678,274	8.67	4,055,614	352	1.17
Sweden	113	1,553,655	7.25	2,033,347	147	342	7,457,949	4.59	7,542,135	346	2.11
Poland	938	4,830,728	19.42	6,749,916	1,311	4,528	33,321,395	13.59	30,315,336	4,120	2.26
Denmark	74	813,369	9.10	1,104,229	100	263	4,598,799	5.72	4,421,804	253	2.69
Cyprus	18	89,549	20.47	148,680	30	83	659,103	12.64	716,913	91	3.00
Finland	86	828,433	10.42	1,223,610	128	277	4,408,874	6.28	4,181,125	263	4.07
The Netherlands	199	2,290,094	8.70	3,238,925	282	562	14,009,162	4.01	13,970,546	560	4.79
EU27	8,457	81,135,808	10.43	102,015,931	10,646	36,757	409,598,277	8.97	394,392,520	35,131	0.08

Data source: Eurostat, Population forecast, baseline 2004

Baseline variant - 1st January population by sex and single year of age

Average value for 2004-2006

Table 6. Number of deaths and number of population of 65+ and 0-64 in 2006
(PIN Flash 9)

Country	Older people (65 and over)		Population aged 0-64		Total	
	deaths	population	deaths	population	deaths	population
Austria	156	1,361,804	574	6,904,121	730	8,265,925
Belgium	193	1,809,017	876	8,702,365	1,069	10,511,382
Bulgaria	184	1,328,479	859	6,390,271	1,043	7,718,750
Cyprus	17	92,342	69	674,072	86	766,414
Czech Republic	173	1,456,391	890	8,794,688	1,063	10,251,079
Denmark	72	823,027	234	4,604,432	306	5,427,459
Estonia	31	227,113	173	1,117,571	204	1,344,684
Finland	71	868,717	265	4,408,238	336	5,276,955
France	901	10,207,129	3,808	52,791,644	4,709	62,998,773
Germany	1,154	15,870,074	3,937	66,567,921	5,091	82,437,995
Greece ⁽¹⁾	320	2,059,616	1,338	9,065,563	1,657	11,125,179
Hungary	216	1,590,712	1,087	8,485,869	1,303	10,076,581
Ireland	66	467,926	299	3,771,922	365	4,239,848
Israel	83	697,600	331	6,419,100	414	7,116,700
Italy	1,220	11,592,335	4,449	47,159,376	5,669	58,751,711
Latvia	63	385,629	344	1,908,961	407	2,294,590
Lithuania ⁽²⁾	122	521,812	638	2,881,472	760	3,403,284
Luxembourg	2	65,974	34	403,126	36	469,100
Malta ⁽³⁾	1	54,379	10	349,967	11	404,346
The Netherlands	210	2,330,459	520	14,003,751	730	16,334,210
Norway	65	682,469	177	3,957,750	242	4,640,219
Poland	919	5,075,823	4,324	33,081,232	5,243	38,157,055
Portugal	215	1,810,100	754	8,759,492	969	10,569,592
Romania	504	3,198,160	2,069	18,412,053	2,573	21,610,213
Slovakia	84	632,638	495	4,760,999	579	5,393,637
Slovenia	33	319,631	229	1,690,746	262	2,010,377
Spain	667	7,308,455	3,437	36,449,795	4,104	43,758,250
Sweden	95	1,565,377	350	7,482,375	445	9,047,752
Switzerland	101	1,192,465	269	6,266,663	370	7,459,128
UK	572	9,687,800	2,728	50,442,500	3,300	60,393,044
EU (27)	8,261	82,710,919	34,789	410,064,522	43,050	493,038,185
PIN (30)	8,510	85,283,453	35,566	426,708,035	44,076	512,254,232

⁽¹⁾ Average of >65 and >66 deaths

⁽²⁾ Older people 64 and over

⁽³⁾ Older people 60 and over

Source: Population figures (Eurostat)

Methodological notes PIN Flash 9

1. Road mortality estimation (Fig.2)

Road mortality is defined as the number of road deaths per 100,000 registered population. Deaths deemed to have resulted from road accidents in a given year and reported to have occurred within 30 days of the accidents are taken into account. The registered population of January 1 is used as denominator in mortality rate calculation formula. In order to get more robust estimate, the mortality rate is estimated from the sum of deaths and population counts in the three most recent years (2004, 2005, 2006).

$$\lambda_{A,i} = Y_{A,i} / N_{A,i}$$

As for the age of accident victims, this is rounded down to the nearest whole number of years in national statistics. In case of Greece, Italy and the Netherlands, the age is rounded to the nearest year.

We do consider two age groups: (1) 0-64 including all accident victims of age under 65 and (2) 65+ including all accident victims 65 years and older.

2. Regression estimation of the average annual percentage change in older people deaths/mortality rates over the period 1997-2006 (Fig.1)

To estimate the average yearly percentage change in deaths/mortality rate for older population occurring between 1996 and 2006 one should make use of the whole time series of counts/mortality rates, not just the counts/death rates in 1996 and 2006.

Since the death rates are based on numbers of deaths, which are for certain countries small numbers subjected to randomness, it is preferred to take as a baseline dated 1997 the mean of the death rates in the three years (1996-1998) instead of using the single value registered in 1997.

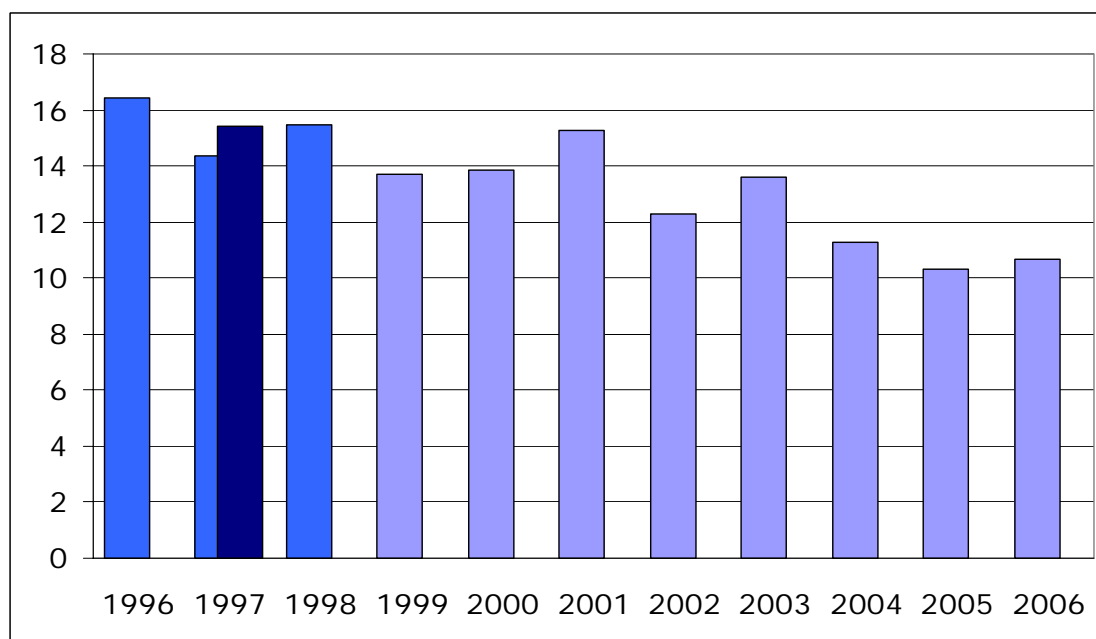


Fig.1: Mortality rate of older population in Belgium with the baseline in 1997

The task is now to estimate the average annual change in the period 1997-2006, while taking the mean of 1996-1998 rates as the reference (baseline).

We assume a priori a reduction in risk of mortality rate over time, so to fix the sign of a change; we will assume reduction, so that a minus sign indicates an increase. Let the average reduction per year as a percentage of the previous year be p . If λ_n is the risk of deaths in year n , then we wish to fit a model $\lambda_n = \lambda_0 \times (1 - p/100)^n$, where in this case year 0 is 1997 and $n = 9$ in 2006.

This is equivalent to $\ln(\lambda_n/\lambda_0) = n \times \ln(1 - p/100)$ so if we fit $\ln(\lambda_n/\lambda_0) = an$ by linear regression, then a is the estimate of $\ln(1 - p/100)$ and p is estimated by $100(1 - e^a)$.

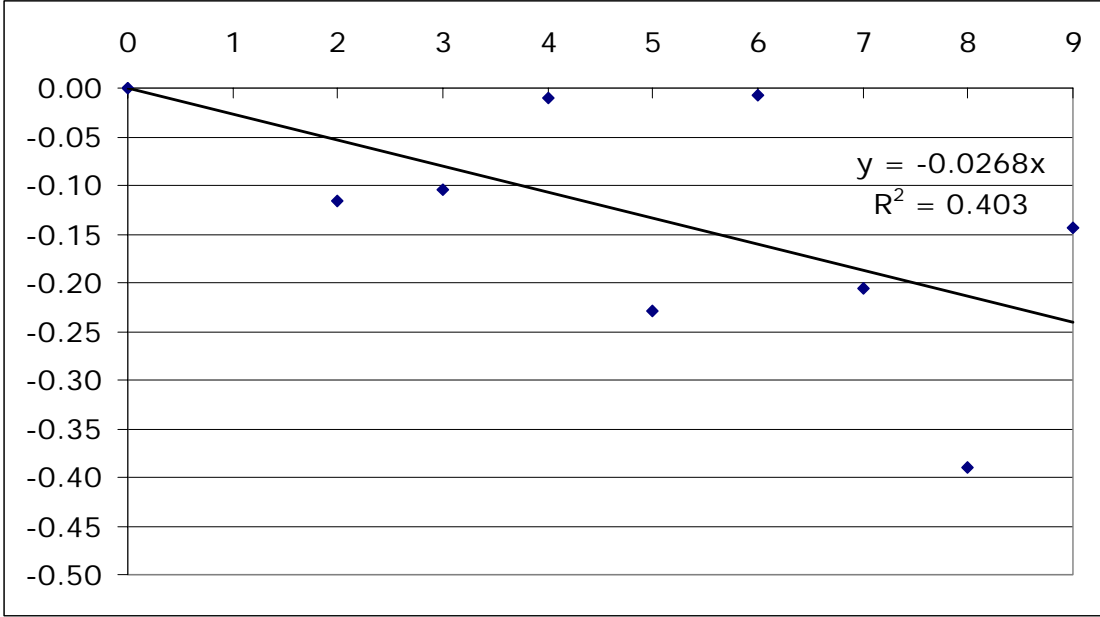


Fig.2: Linear regression function for logarithmically transformed changes in death rate since 1997 as baseline

In this figure illustrating the use of the method and constructed for Belgium, the function $\ln(\lambda_n/\lambda_0) = an$ corresponds to the function $y=ax$, so the a is equal -0.0268 . The p can now be estimated as $100(1 - e^a) = 100(1 - e^{-0.0268}) = 2.64$. Average yearly reduction in older mortality is thus estimated as 2.6%. One can conclude that over the last 10 years, the mortality rate of older has decreased annually by almost 3%.

3. Estimation of the impact of population ageing on the number of road deaths (Fig. 5)

Road mortality of older people is higher than the mortality of the rest of the population for many countries considered under PIN programme. The ratio of mortality for these two groups is 1.16 for the Europe as a whole, but it varies between 0.89 (Latvia) and 2.17 (The Netherlands). Under the hypothesis that this ratio will not change in the future, one can estimate the effect of demographic changes on road deaths.

Road mortality in any age group is defined as the number of deaths in this group divided by the number of inhabitants in that group.

$$\lambda_{A,i} = Y_{A,i} / N_{A,i}$$

Assuming no change in mortality rates over time (or at least a homogenous change across age groups), the demographical changes will have a proportional effect on the number of expected deaths.

The expected number of deaths in any age group is given by:

$$Y_{A,i,exp} = N_{A,i,exp} \times \lambda_{A,i}$$

Adjusting for the change in total population, under the assumption of the linearity between the number of deaths and population, we may estimate the effect on the number of deaths as follows:

$$\zeta_i = \frac{Y_{A,i,exp} \times N_{A,i,exp}}{Y_{A,i} \times N_{A,i}} = \frac{(Y_{E,i,exp} + Y_{R,i,exp}) \times N_{A,i,exp}}{(Y_{E,i} + Y_{R,i}) \times N_{A,i}} = \frac{[(N_{E,i,exp} \times \lambda_{E,i,exp}) + (N_{R,i,exp} \times \lambda_{R,i,exp})] \times N_{A,i,exp}}{(Y_{E,i} + Y_{R,i}) \times N_{A,i}}$$

The coefficient of increase in road deaths due to demographic changes shows the effect of population ageing in road deaths and means an expected increase of deaths for total population due to the increased proportion of older people in the total population.

Indices employed: A... any group, E... older people, R... total minus older people

Example: Expected impact of population ageing on road deaths in Ireland by 2020

There were 60 deaths among older people registered for 459,842 older citizens and 319 other deaths for remaining 3,678,274 citizens in 2005 (as the average of counts registered in 2004, 2005 and 2006). By 2020, the population of older people is expected to grow to 700,497, while the rest of population to grow to 4,055,614.

Mortality rates in 2005 for older people and the rest of the population

$$\lambda_{E,i} = Y_{E,i} / N_{E,i} = 60/459,842 (\times 100,000) = 12.98$$

$$\lambda_{R,i} = Y_{R,i} / N_{R,i} = 319/3,678,274 (\times 100,000) = 8.67$$

The expected number of deaths in the two age groups is estimated as:

$$Y_{E,i,exp} = N_{E,i,exp} \times \lambda_{E,i} = 700,497 \times 12.98 (/100,000) = 91$$

$$Y_{R,i,exp} = N_{R,i,exp} \times \lambda_{R,i} = 4,055,614 \times 8.67 (/100,000) = 352$$

The effect of the population ageing on the number of expected deaths is then:

$$\zeta_i = \frac{(Y_{E,i,exp} + Y_{R,i,exp}) \times N_{A,i,exp}}{(Y_{E,i} + Y_{R,i}) \times N_{A,i}} = \frac{(91 + 352) \times 4,756,111}{(60 + 319) \times 4,138,116} = 1.017$$

Population ageing in Ireland should lead to a 1.7% increase of the number of road deaths by 2020 assuming the hypotheses presented earlier.