Road Safety PIN

Table 1. Deaths on motorways* per billion vehicle-km in 2006
(PIN Flash 8 Fig. 1)

Country	Number of deaths on motorways	Vehicle-km on motorways (billions)	Deaths per billion vehicle-km in 2006
Switzerland	31	22.00	1.41
Denmark	19	12.65	1.50
The Netherlands[1]	92	53.48[2]	1.72
Great Britain	187	99.20	1.89
Sweden	28	13.00	2.15
France	296	125.00	2.37
Ireland	11	3.75	2.39
Germany	645	217.10	2.97
Finland	17	5.63	3.02
Israel	16	5.14	3.11
Austria[3]	80	19.17	4.17
Norway[4]	9	2.00	4.50
Belgium	163	34.08	4.78
Czech Republic	37	6.75	5.49
Italy[5]	456	81.89	5.57
Portugal	74	10.95	6.76
Spain[6]	827	120.00	6.89
Slovenia	29	3.34	8.69
Hungary[7]	55	6.22	8.84
EU (16) average	3016	812	3.71
PIN (19) average[8]	3063	839	3.65

Source: national data provided by PIN panelists, CARE and IRTAD

* Motorways are roads with dual carriageways, at least two lanes each way; entrance and exit signposted; grade separated interchanges; central barrier or central reservation; no crossing movements at the same level; no stopping permitted unless in an emergency. Use of motorways on foot and by some types of vehicle is restricted in various ways in different countries.

[1] Data for the Netherlands only cover the national network administrated by Rijkswaterstaat

[2] Estimation based on the rough assumption that 40% of all motor vehicle-km are on motorways

[3] Motorways and express roads (Autobahn and Schnellstrasse)

[4] 2005

[5] Data for Italy only cover the network that belong to the Association of Italian toll motorway and tunnel concessionaires (AISCAT)

[6] Motorways and Autovia. Autovia are express roads where some of the motorway design requirements are not fulfilled

[7] National road network only

[9] EU (16) average plus Israel, Norway and Switzerland

Table 2. Deaths on motorway per billion vehicle-km and their average yearly percentage change over the period 1997-2006
(PIN Flash 8 Fig. 2)

Country	Deaths per billion vehicle-km / Year											Average yearly % change over 1997-2006 in the risk of death on motorways
	1996[*]	1997[*]	1998[*]	1999	2000	2001	2002	2003	2004	2005	2006	
Norway							7.4	9.6	2.6	4.5		*- 21.0 %*
Switzerland	4.2	5.0	3.7	3.3	2.3	3.6	3.8	2.9	2.4	1.1	1.4	- 10.0 %
Slovenia	23.2	13.6	17.3	10.3	13.8	10.2	10.8	9.4	7.7	8.7	8.7	- 9.7 %
The Netherlands[1]	4.2	3.4	2.8	3.1	2.3	1.9	1.9	2.4	1.6	1.7	1.7	- 8.9 %
Portugal			13.9	13.3	12.8	10.3	9.9	10.0	9.0	7.9	6.8	*- 8.5 %*
Spain[2]	1.73	15.4	16.8	14.4	14.0	13.0	11.9	10.4	8.4	7.2	6.9	- 8.5 %
France	5.2	5.2	5.2	4.8	5.0	4.4	4.5	3.8	2.7	2.7	2.4	- 7.0 %
Hungary[3]	20.7	17.7	14.9	15.3	15.9	10.2	15.6	14.0	11.9	8.2	8.8	- 6.9 %
Czech Republic	16.0	11.4	13.3	12.2	11.2	10.5	12.0	9.9	11.0	7.2	5.5	- 6.5 %
Italy[4]	10.2	10.4	10.0	9.9	8.4	8.2	8.3	7.1	5.9	5.7	5.6	- 6.3%
Denmark	4.2	5.0	3.7	4.6	3.0	4.1	5.0	3.1	2.8	3.1	1.5	- 5.9 %
Belgium	7.4	6.9	7.5	6.9	7.6	6.2	5.4	4.3	3.8	4.8	4.8	- 5.8 %
Finland	2.4	4.2	5.7	5.1	4.3	4.5	4.1	1.4	3.4	1.9	3.0	- 5.4 %
Germany	5.6	5.0	4.2	4.6	4.5	3.8	4.1	3.8	3.2	3.1	3.0	- 5.3 %
Austria[5]	7.4	8.3	9.7	9.1	8.1	9.1	7.2	5.9	6.7	4.8	4.2	- 5.2%
Sweden	2.5	5.0	2.3	2.3	2.8	2.8	2.4	2.8	3.5	1.9	2.2	- 4.3 %
Great Britain	2.1	2.2	2.0	2.2	2.1	2.1	2.3	2.2	1.6	2.0	1.9	- 0.7 %
EU (15) average	6.8	6.5	6.3	6.2	5.9	5.5	5.5	4.9	4.1	3.9	3.7	- 5.6 %
PIN (17) average[6]	6.7	6.4	6.3	6.1	5.8	5.4	5.4	4.9	4.0	3.8	3.6	- 5.7 %

Source: national data provided by PIN panelists, CARE and IRTAD

[*] Since the numbers of deaths on motorways are often small numbers subjected to randomness, the mean of the three years (1996, 1997, 1998) was used as baseline dated 1997 instead of using the single value registered in 1997. (Except Portugal: 1998, 1999, 2000)
[1] Estimated value based on the assumption that 40% of all motor vehicle kilometers travelled on motorways
[2] Motorways and Autovia included
[3] National road network only
[4] Data for Italy only cover the network that belongs to the Association of Italian toll motorway and tunnel (AISCAT)
[5] Motorways and express roads (Autobahn and Schnellstrasse)
[6] EU (15) average plus Israel and Switzerland
NO, IL and FI are excluded from Fig. 2. The annual numbers of deaths in Finland and Norway are below 20 and thus subject to substantial random fluctuation. IL could not be included because vehicle-km are available only for 2005 and 2006.
The methodology to estimate the average yearly % change in the risk of death is explained in the PIN Flash 8 Methodological Note available on www.etsc.be/PIN

Table 3. Deaths on motorway and their average yearly percentage change over the period 2001-2006
(PIN Flash 8 Fig. 3)

Country	Deaths on motorway / Year							Average yearly % change
	2000[*]	2001[*]	2002[*]	2003	2004	2005	2006	
Switzerland	43	71	76	58	51	25	31	- 13.4 %
Norway		13	9	18	5	9		- 11.9 %
Luxembourg	10	8	10	6	7	5	5	- 11.3 %
France	533	493	527	444	326	324	296	- 10.9 %
Austria[1]	135	157	128	108	125	92	80	- 9.4 %
Denmark	29	40	51	33	31	37	19	- 8.6 %
Finland	17	19	19	7	17	10	17	- 8.6 %
Belgium	233	193	170	137	124	158	163	- 7.4 %
Spain[2]	1153	1178	1126	1083	930	852	827	- 6.4 %
Italy[3]	589	598	625	553	468	451	456	- 6.1 %
Germany	907	770	857	811	694	662	645	- 5.3 %
Poland	44	57	40	36	35	32	54	- 4.3 %
Portugal	112	98	101	111	102	86	74	- 4.2 %
Cyprus	11	11	15	10	11	12	10	- 3.1 %
The Netherlands[4]	110	95	101	125	85	93	92	- 1.9 %
Great Britain	182	191	217	208	158	195	187	- 1.3 %
Czech Republic	45	43	53	48	58	45	37	- 1.0 %
Israel	13	25	25	20	28	26	16	0.8 %
Slovenia	26	20	23	22	21	25	29	2.1 %
Hungary[5]	49	32	54	58	60	47	55	5.1 %
Sweden	25	28	26	34	42	24	28	5.2 %
Slovakia	13	7	19	16	20	19	15	8.2 %
Ireland	4	4	5	9	6	3	11	11.1 %
Greece	61	86	69	58	116	111	147	12.0 %
EU (21) average	4 128	4 236	3 915	3 436	3 283	3 247	3 289	-5.5 %
PIN (23) average[6]	4 224	4 337	3 995	3 515	3 334	3 294	2 962	-5.6%

Source: national data provided by PIN panelists and CARE

[*] Since the numbers of deaths on motorways are often small numbers subjected to randomness, the mean of the numbers of deaths in the three years (2000, 2001, 2002) was used as baseline dated 2001 instead of using the single value registered in 2001.

[1] Motorways and express roads (Autobahn and Schnellstrasse)

[2] Motorways and Autovia

[3] Data for Italy only cover the network that belongs to the Association of Italian toll motorway and tunnel (AISCAT)

[4] Data for the Netherlands only cover the national network administrated by Rijkswaterstaat

[5] National road network only

[6] EU (21) average plus Israel and Switzerland

* CY, FI, IR, LU, NO and SK are excluded from Fig. 3 as the annual numbers of deaths are below 20 and thus subject to substantial random fluctuation.

The methodology to estimate the average yearly % change in deaths is explained in the PIN Flash 8 Methodological Note available on www.etsc.be/PIN

Methodological notes PIN Flash 8

1. Regression estimation of average annual percentage change in risk of death on motorways over the period 1997-2006

To estimate the average yearly percentage change in fatality risk on motorways (deaths per kilometre driven by all motorized vehicles on motorways) achieved by a country between 1996 and 2006 one should make use of the whole time series of risk rates, not just the risk rates in 1996 and 2006.

Since the death rates are based on numbers of deaths on motorways, which are often 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.
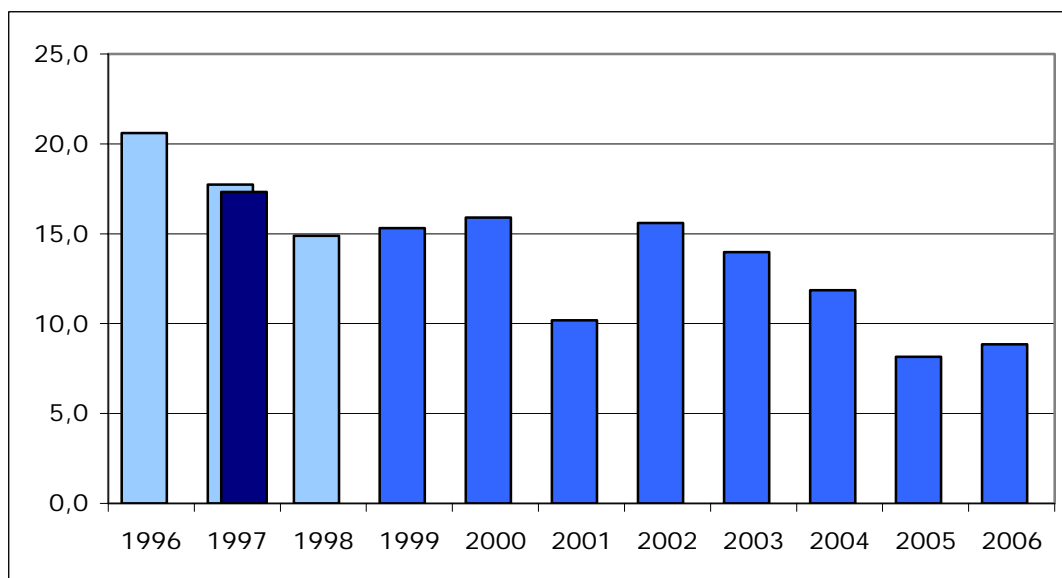

Fig.1: Risk of death on motorways in Hungary with the baseline in 1997The task is now to estimate the average annual change in the period 1997-2006, while taking the mean of 1996-1998 rates as the reference (baseline).

We assume a priori a reduction in risk of death on motorways 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 $\lambda_n = \lambda_0(1 - p/100)^n$, where in this case year 0 is 1997 and $n = 9$ in 2006.

This is equivalent to $\ln(\lambda_n/\lambda_0) = n. \ln(1-p/100)$ 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 $100(1 - e^a)$.
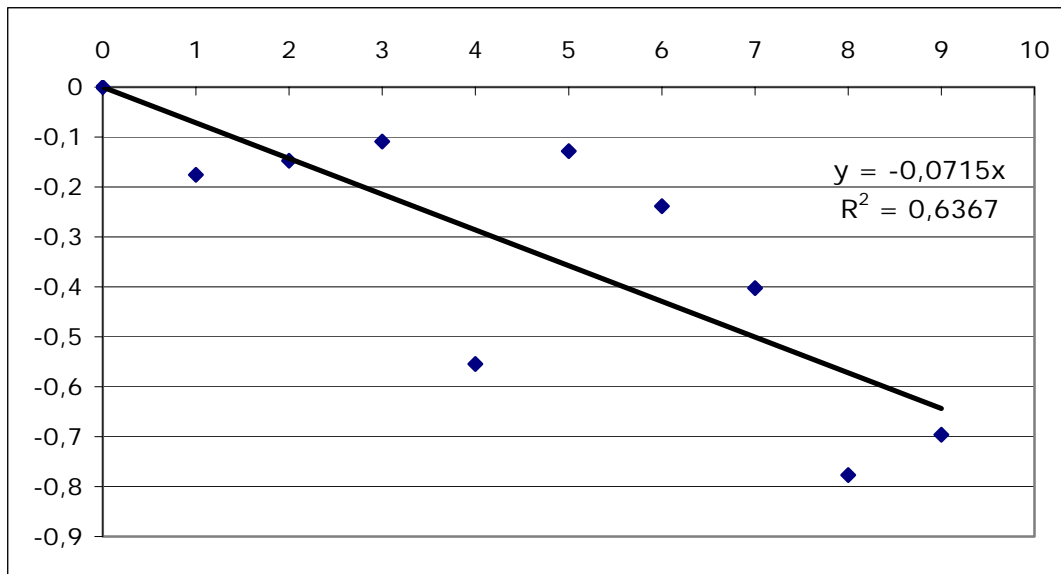
Fig.2: Linear regression function for logarithmically transformed changes since 1997 as baseline

In this figure illustrating the use of the method and constructed for Hungary, the function $\ln(\lambda_n/\lambda_0) = an$ corresponds to the function $y=ax$, so the a is equal -0.0715. The p can now be estimated as $100(1 - e^a) = 100(1 - e^{-0.0715}) = 6.90$. Average yearly reduction in PTW rider deaths is thus estimated as 6.9%. One can conclude that over the last 10 years, the risk of deaths on Hungarian motorways has decreased annually by almost 7%.

2. Regression estimation of average annual percentage change in number of deaths on motorways over the period 2001-2006

The same regression estimation method as above is applied for the estimation of the average yearly change in the number of deaths on motorways between the year 2001 and 2006. The mean of the numbers of deaths in the three years 2000-2002 is taken as a baseline dated 2001, instead of using the single value registered in 2001.