



Ministry of
JUSTICE

Reporting of deaths in custody

Ministry of Justice

Technical note: discussion of
measurement of trends in deaths
in custody – standardised mortality
rates methodology

Published 28 July 2011

Introduction

In February 2010, Justice Statistics Analytical Services, Ministry of Justice published *Safety in Custody*, a statistics bulletin containing data on deaths in custody, including data on self-harm and assaults. This was the first publication of this data and as such was well-received. However, improvements to reporting methods have been under consideration since publication.

Reporting trends in deaths in custody is problematic because the total number of deaths is relatively small and small changes year on year produce disproportionately large percentage increases or decreases. Table 1 which appeared in the first publication shows that in 2009, there were 168 prisoners who died, out of a total average prison population of 83,461 prisoners. In 2008, 165 prisoners died out of an average population of 82,572 prisoners.¹ So the 2009 figure represents an increase of 1.8% on 2008. The crude death rate for the prison population was 0.20% for both 2008 and 2009, the small increase of 0.0015% from 2008 to 2009 being lost when rounding to two decimal places. In an effort to smooth the data, 3-year rolling averages were produced.

These averages were published in units of both 1,000 and 100,000. This is because descriptive statistics of populations are typically expressed in units smaller than the total (the prison population being less than 100,000) while data in units of 100,000 was provided to facilitate comparison with wider population statistics. Presenting the rates in units of 100,000 only serves to highlight the problems associated with small data sets.

¹ "Safety in custody statistics 2008/2009, Prisons and probation, *Safety in custody*," *Justice*, Ministry of Justice, <http://www.justice.gov.uk/publications/safer-custody.htm> (accessed 21 July 2011).

Table 1: Summary statistics, Safety in Custody statistical bulletin 2008/09²

	England and Wales									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Prison Population¹	64,602	66,301	70,778	73,038	74,657	75,979	78,127	80,216	82,572	83,461
Deaths in prison custody²	147	142	164	183	208	174	153	185	165	168
Self-inflicted	81	73	95	95	95	78	67	92	60	60
Natural Causes	62	68	66	86	102	88	83	91	99	105
Other non-natural	1	1	3	1	9	5	3	0	3	3
Homicide	3	0	0	1	2	3	0	2	3	0
3-year rolling average per 1,000 prisoners										
Deaths in prison custody²	-	-	2.24	2.32	2.54	2.53	2.34	2.18	2.09	2.11
Self-inflicted deaths	-	-	1.23	1.25	1.31	1.20	1.05	1.01	0.91	0.86
Natural cause deaths	-	-	0.97	1.05	1.16	1.23	1.20	1.12	1.13	1.20
3-year rolling average per 100,000 prisoners										
Deaths in prison custody²	-	-	224	232	254	253	234	218	209	211
Self-inflicted deaths	-	-	123	125	131	120	105	101	91	86
Natural cause deaths	-	-	97	105	116	123	120	112	113	120

(1) Population statistics are derived from the Ministry of Justice- Offender Management Caseload Statistics. The prison population figure shown for 2009 is provisional.

(2) Deaths in prison custody statistics are derived from the National Offender Management Service (NOMS) deaths in the custody database which contains details of all deaths in prison custody for England and Wales from 1978.

Comparison of data with the wider population requires more than common units of measurement. Differences between populations such as age and sex need to be acknowledged and controlled for. The Department of Health uses standardised mortality ratios (SMRs) to compare mortality rates in hospitals.³ An SMR has the advantage of summarising differences between populations in one statistic while controlling for differences in distribution of age and sex.

Table 2 shows a summary table similar to Table 1 but with the addition of SMRs and 3-year rolling averages replaced by a single year annual average, as published in the Safety in Custody bulletin in July 2011:-

² "Safety in custody statistics 2008/2009", Ministry of Justice, <http://www.justice.gov.uk/publications/safer-custody.htm> (accessed 21 July 2011).

³ "Template for Calculating Age-Standardised Mortality Rates (Direct standardization)," *London Health Observatory*, London Health Observatory, <http://www.lho.org.uk/viewResource.aspx?id=9275> (accessed 21 July 2011).

Table 2: Summary statistics, Safety in Custody statistical bulletin 2010⁴

	England and Wales									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Prison Population¹	66,301	70,778	73,038	74,657	75,979	78,127	80,216	82,572	83,559	84,725
Deaths in prison custody²	142	164	183	208	174	153	185	165	169	196
Self-inflicted	73	95	95	95	78	67	92	60	60	58
Natural Causes	68	66	86	102	88	83	91	99	105	124
Other non-natural	1	3	1	9	5	3	0	3	3	5
Homicide	0	0	1	2	3	0	2	3	0	1
Unclassified	-	-	-	-	-	-	-	-	-	8
Rates per 1,000 prisoners³										
Deaths in prison custody²	2.14	2.32	2.51	2.79	2.29	1.96	2.31	2.00	2.02	2.31
Self-inflicted deaths	1.10	1.34	1.30	1.27	1.03	0.86	1.15	0.73	0.72	-
Natural cause deaths	1.03	0.93	1.18	1.37	1.16	1.06	1.13	1.20	1.26	-
Standardised Mortality Ratio (SMR)⁴		1.29	1.39	1.59	1.30	1.10	1.29	1.08	1.10	1.25
SMR confidence interval		(1.13-1.47)	(1.23-1.58)	(1.41-1.78)	(1.14-1.48)	(0.96-1.25)	(1.14-1.45)	(0.95-1.23)	(0.96-1.25)	(1.11-1.41)

(1) Prison population averaged across 12 months. See MOJ's Offender Management annual statistics Table A1.2.

(2) Deaths in prison custody statistics are derived from the National Offender Management Service (NOMS) deaths in the custody database which contains details of all deaths in prison custody for England and Wales from 1978.

(3) These rates have been calculated using the average prison population for each year. Rates are not shown for 2010 self-inflicted and natural causes deaths due to the relatively high number of currently unclassified deaths.

(4) See Appendix B and the associated technical note 'Reporting of deaths in custody' on the website.

Standardised mortality ratios (SMRs)

Major differences between the general population and the prison population are total size and age and sex distributions. The prison population data in Figure 1⁵ is presented on a scale of units of 5,000 whereas the general population data in Figure 2⁶ is presented in units of 5,000,000 because the population of England and Wales is nearly 900 times the size of the prison population. Age and sex distribution also differs considerably between the prison and general population. The prison population by definition only covers prisoners aged 15 years and over. It also has considerably fewer prisoners aged 60 years and over. Female prisoners constitute 5% of the total prison population compared with 51% of the general population of England and Wales.

⁴ "Safety in custody statistics 2010", *Ministry of Justice*, <http://www.justice.gov.uk/publications/safer-custody.htm> (accessed 28 July 2011).

⁵ Derived from data in Table A1.1, "Population, Offender management caseload statistics 2010 tables", *Ministry of Justice*, <http://www.justice.gov.uk/publications/statistics-and-data/prisons-and-probation/oms-quarterly.htm> (accessed 28 July 2011).

⁶ Data from "England and Wales population estimates and projections 1961-2083, The interactive population pyramid" *Office for National Statistics*, http://www.statistics.gov.uk/populationestimates/flash_pyramid/default.htm (accessed 21 July 2011).

Figure 1: Total prison population of England and Wales, as at 30 June 2010

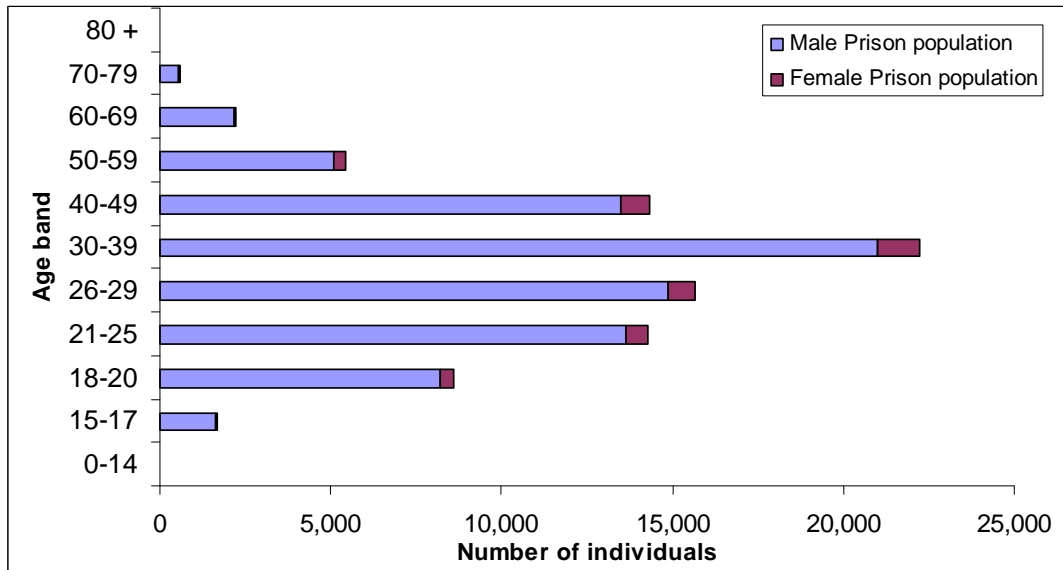
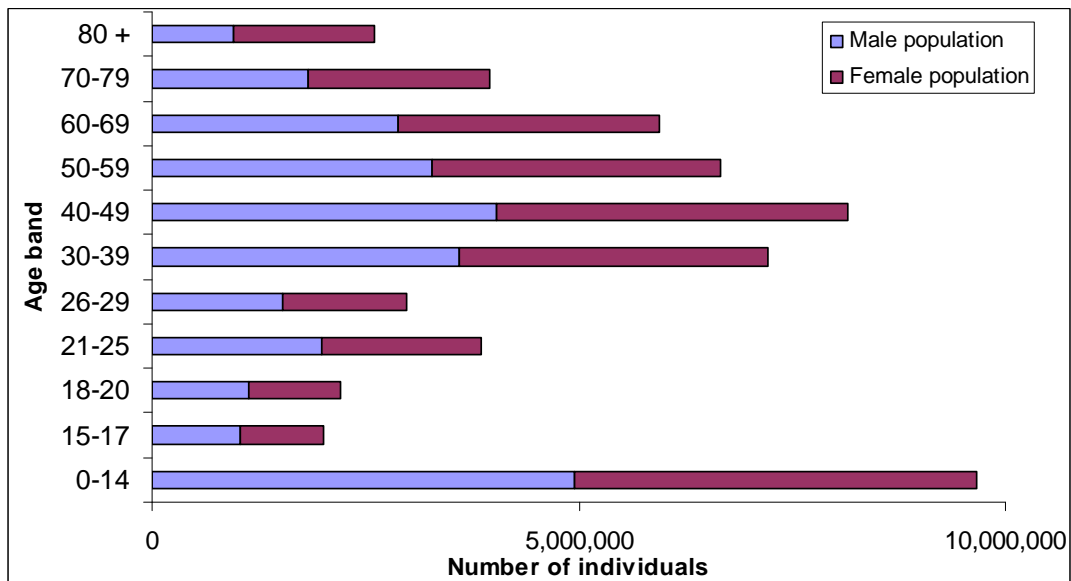


Figure 2: Population of England and Wales, 2010



Standardising total mortality ratios for age and sex factors out differences between age and sex distributions. Selecting the general population of England and Wales as the standard population and the population in prison in England and Wales as the index population, estimated deaths in the prison population have been calculated in Table 2 using indirect standardisation by multiplying numbers of the index population categories by death rates in the standard population for both sexes. The indirect method was chosen because of the relatively small size of events in the index population.

Table 2: SMR calculations

Age band	Male population estimate England and Wales 2010 ¹ (N)	Female population estimate England and Wales 2010 ¹ (N)	Male deaths (England and Wales) 2010 ² (R)	Female deaths (England and Wales) 2010 ² (R)	Male mortality rate: Deaths/Total population (P)	Female mortality rate: Deaths/Total population (P)	Male Prison population 2010 ³ (n)	Female Prison population 2010 ³ (n)	Estimated deaths in custody (P X n)	Recorded deaths in custody (England and Wales) 2010 ⁴ (r)
0-14	4,944,600	4,717,700	2,328	1,931	0.0005	0.0004	0	0	0.0	0
15-17	1,033,200	974,700	262	186	0.0003	0.0002	1,628	28	0.4	0
18-20	1,134,600	1,068,600	537	231	0.0005	0.0002	8,205	373	4.0	4
21-25	1,982,300	1,876,300	1,127	416	0.0006	0.0002	13,653	621	7.9	6
26-29	1,524,300	1,461,500	985	480	0.0006	0.0003	14,864	822	9.9	10
30-39	3,607,900	3,600,200	3,902	2,135	0.0011	0.0006	20,992	1,228	23.4	30
40-49	4,037,700	4,111,500	8,769	5,610	0.0022	0.0014	13,502	823	30.4	48
50-59	3,283,200	3,375,100	16,937	11,551	0.0052	0.0034	5,105	309	27.4	39
60-69	2,888,900	3,051,500	36,340	24,133	0.0126	0.0079	2,165	55	27.7	33
70-79	1,828,400	2,131,600	61,684	48,367	0.0337	0.0227	566	8	19.3	21
80 and over	963,700	1,643,400	105,045	160,286	0.1090	0.0975	55	0	6.0	5
total	27,228,800	28,012,100	237,916	255,326	0.0087	0.0091	80,735	4,267	156.4	196

1) "England and Wales population estimates and projections 1961-2083, The interactive population pyramid," *Office for National Statistics*, Office for National Statistics, http://www.statistics.gov.uk/populationestimates/flash_pyramid/default.htm (accessed 21 July 2011).

2) "Tables 3 and 4, Death Registrations by sex and single year of age, 1961 to 2010, England and Wales and UK, Death registrations in England and Wales, selected data tables," *Office for National Statistics*, Office for National Statistics <http://www.statistics.gov.uk/statbase/Product.asp?vlnk=14409> (accessed 21 July 2011).

3) Based on data used to produce "Table A1.1, Population, Offender management caseload statistics 2010 tables, Prisons and probation, Offender management statistics quarterly bulletin" *Justice*, Ministry of Justice, <http://www.justice.gov.uk/publications/statistics-and-data/prisons-and-probation/oms-quarterly.htm> (accessed 28 July 2011).

4) "Safety in custody statistics 2010, Prisons and probation, Safety in custody," *Justice*, Ministry of Justice, <http://www.justice.gov.uk/publications/safer-custody.htm> (accessed 28 July 2011).

$$SMR = \frac{\sum r}{\sum (P \times n)}$$

$$= 1.25$$

If the index and standard populations had the same mortality rates, the SMR would be 1.0. To understand whether an SMR indicates a statistically significant difference between the mortality rates of the index and standard populations requires calculation of upper and lower bounds⁷ for the 95% confidence interval defined as:-

$$SMR_L = SMR \left(1 - \frac{Z_\alpha}{2 \times \text{observed}^{\frac{1}{2}}} \right)^2$$

$$= 1.11$$

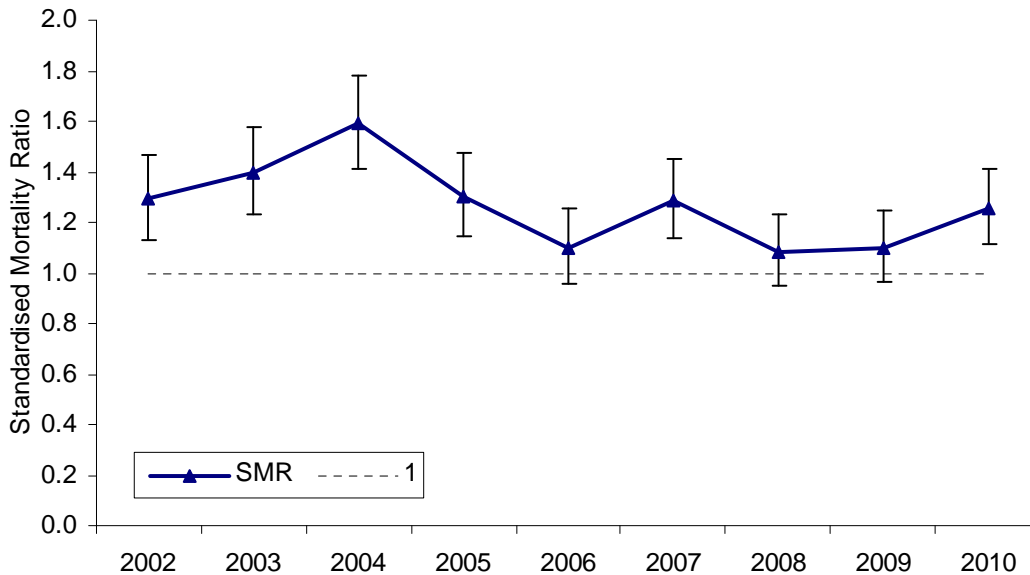
⁷ N. E. Breslow and N. E. Day, "Statistical Methods in Cancer Research, Vol. 2: The Design and Analysis of Cohort Studies." *International Agency for Research on Cancer Scientific Publications*, no. 82 (1987). <http://www.iarc.fr/en/publications/pdfs-online/stat/> (accessed 21 July 2011).

$$SMR_U = SMR \left(\frac{observed + 1}{observed} \right) \left(1 + \frac{Z_\alpha}{2(observed + 1)^{\frac{1}{2}}} \right)^2$$

$$= 1.41$$

Since the value of the 2010 SMR is between 1.11 and 1.41, an interval which does not include 1, the difference between the death rate of the general population and the population in custody is statistically significant at the 95% confidence interval. Figure 3 shows the SMR and confidence intervals since 2002.

Figure 3: SMR for Prison Population in England and Wales, 2002-2010



Units of measurement

The dictionary definition of a rate is, “a measure, quantity, or frequency, typically one measured against another quantity or measure.” Rates of deaths in custody were published as both the number of deaths per 1,000 and 100,000 prisoners. The rate per 1,000 was chosen because the prison population is less than 100,000 but the rate per 100,000 was provided to facilitate comparison with other population statistics. Population statistics for the UK are reported in units of 100,000 because the total population is larger than 100,000.

While there is no rule governing use of units of measurement for deaths or population statistics, deaths statistics published on the internet are more commonly reported as actual figures. The Office for National Statistics (ONS) website reports rates of death for circulatory diseases, cancer and respiratory diseases and standardised mortality rates using units of 1,000,000. Elsewhere, ONS standardised mortality rates are reported using units of 100,000 when subdivided into cause. The Eurostat website reports actual data as well as crude death rates using units of 100,000 and standardised death rates in terms of the average European mortality rate. The World Health Organisation website reports age-specific rates of registered deaths by cause using units of 100,000.

Rates for smaller populations such as infants and national data broken down by age-specific categories use units of 1,000. Appendix A contains a brief survey of mortality rates as published on the internet.

Conclusion

Standardised mortality ratios for the prison population together with confidence intervals provide context to differences between mortality rates in custody compared to the UK population. Publication of an annual SMR provides a more consistent measure of change than actual data or a three-year-rolling average.

Rates other than standardised mortality ratios could be published per 100,000 in line with other population statistics but the numbers could be construed as misleading due to the fact that they describe a unit larger than the total population in custody. Since the prison SMR uses UK population data as part of the calculation, direct comparison of data with ONS population statistics is unnecessary. As the total prison population is less than 100,000, to avoid highlighting small year-on-year changes, rates should be published per 1,000 prisoners.

As an area for future research we intend to look more closely at the reporting of self-inflicted deaths to enable more detailed analysis.

Appendix A

Survey of online sources of mortality rates

	Infant mortality Per 1,000	General mortality				Significant places (max used)	Format
		Per 1,000	Per 10,000	Per 100,000	Per 1,000,000		
GENERAL MORTALITY RATES							
ONS (Death registrations in England and Wales Death rates) Age-standardised mortality rate, all ages, all causes, per million population						4	Integer
Age-specific mortality rates per 1,000 population		↗				4	1 decimal point
Age standardised alcohol deaths				↗			
Cancer research -UK Mortality rates of breast cancer				↗		3	1 decimal point
The Poverty Site (UK) Infant death rates	↗					2	1 decimal point
World Health statistics Infant mortality rate	↗						Integer
Age-standardized mortality rate by cause				↗			Integer
Eurostat mortality statistics Causes of death by gender				↗		5	1 decimal point
Australia Age specific death rates		↗					
United Nations Infant mortality rate	↗					3	Integer
Maternal mortality ratio				↗		3	Integer
Canada Age standardised mortality rates				↗		4	1 decimal point
Suicides and suicide rate				↗		3	1 decimal point
Ireland Overall death rate		↗				3	1 decimal point
Scotland Age specific death rate		↗				1	1 decimal point
New Zealand (Access not allowed by Quantum))							
France Taux de mortalité		↗				2	1 decimal point
CIA Fact book Death rate by country		↗				3 or 4	1/2 decimal points
Kaiser Family Foundation (US) Mortality rates				↗			
International transport forum Traffic deaths				↗			
Wikipedia Mortality rates		↗				3	1 decimal point
Deaths by cause				↗		4	1 decimal point
PRISON RELATED MORTALITY STATISTICS							
Ministry of Justice Offender Management Caseload Statistics: Death rates		↗				2	1 decimal point
Bureau of justice statistics (US) Mortality rates of prisoners				↗			
Council of Europe (Penal Statistics) Mortality and suicide rate (Page 75 table 15.1)			↗			3	1 decimal point
RESEARCH							
Using mortality rates as a health outcome indicator. A literature Review (2000) (This review mostly uses % but provides a useful indication of rates used by other researchers.)		↗8	↗2	↗10			
Suicide in Australia (Wesley Mission 2000)				↗			

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