



29th March 2012

Theme: Other - Defence

Issued by

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**1990/1991 GULF CONFLICT – UK GULF VETERANS MORTALITY
DATA: CAUSES OF DEATH**

INTRODUCTION

1. This annual Statistical Notice provides summary statistics on the causes of deaths that occurred among the UK veterans of the 1990/91 Gulf Conflict between 1 April 1991 and 31 December 2011. These statistics are based on deaths in this time period that were reported to the Ministry of Defence (MOD) by 10 February 2012. This report updates the previous notice for deaths that occurred up to 31 December 2010 released on 31 March 2011. Information on deaths that may have occurred during the period 1 April 1991 to 31 December 2011 but are reported to the MOD after the release of this publication will be added to future publications.
2. The purpose of this Statistical Notice is to compare the mortality rates of 53,409 UK Armed Forces personnel that deployed to the 1990/91 Gulf Conflict to those of a comparison group, the Era cohort. The Era cohort consists of 53,143 UK Armed Forces personnel of similar age, gender, Service, regular/reservist status and rank who were in Service on 1 January 1991 but did not deploy to the Gulf. The findings include deaths that occurred to personnel whilst in service and deaths that occurred after personnel had left the UK Armed Forces.
3. This Statistical Notice also compares the mortality rates of Gulf veterans and the Era comparison group to rates observed in the UK general population over the same time period. This enables the mortality rates of the Gulf and Era cohorts to be placed in context. This analysis is presented as age and gender standardised mortality rates and, for the first time, Standardised Mortality Ratios (SMRs).
4. The Statistical Notice published on 17 January 2005 discussed the issue of an age bias found within the cohorts used to produce this series of Statistical Notices. The **Background notes** of this report give further details of the findings. Age adjusted estimates are provided in this report for the Era cohort to account for differences in the age profile of those in the Gulf and Era cohorts who were aged 40 and above on 1 January 1991.

KEY POINTS

5. There were 1,283 deaths among the Gulf veterans up to 31 December 2011 and 1,364 deaths in the Era comparison group, representing increases of 90 and 112 respectively since the last release of this Statistical Notice in March 2011. These increases result in an estimate of 1,327 deaths in the age-adjusted Era comparison group. (**Table 1**)
6. There was no statistically significant difference in the total number of deaths between the Gulf veterans and the age-adjusted Era comparison group. (**Table 1**)
7. The number of disease-related deaths among Gulf veterans was statistically significantly lower than in the age-adjusted Era comparison group, with 738 deaths compared with an estimate of 825 respectively. No statistically significant difference was found in the last release, therefore this finding will be monitored in subsequent reports to ascertain if the finding is real or has

occurred by chance. (**Table 1**)

8. There were no statistically significant differences in the total number of deaths due to neoplasms between the Gulf veterans and the age-adjusted Era comparison group. However, the numbers of deaths within two of the specific cancer sites were statistically significantly lower among Gulf 1 veterans than in the Era comparison group; for malignant neoplasm of the colon there were 13 and 26 deaths respectively and for malignant neoplasm of the bronchus and lung there were 39 and 62 deaths respectively. These findings will continue to be monitored in subsequent reports to ascertain if they are real or have occurred by chance. (**Table 2**)
9. UK general population mortality rates were applied to the age and gender profile of the Gulf cohort to estimate comparable mortality rates. There would have been an estimated 2,191 deaths among Gulf veterans if they had experienced the age and gender specific mortality rates of the UK general population, compared to the 1,283 deaths that have actually occurred between 1 April 1991 and 31 December 2011 (**Figure 2**).
10. Standardised Mortality Ratios (SMR) were calculated for both the Gulf and Era cohorts covering all deaths from 1991 to 2011. The SMRs showed that there was a statistically significant decreased risk of dying in both the Gulf and Era cohorts compared to the UK general population (**Table 3**).

RESULTS

Comparisons between Gulf veterans and Era cohort

All deaths

11. **Table 1** provides details of the number of deaths to personnel who deployed to the 1990/91 Gulf Conflict and the Era comparison group between 1 April 1991 and 31 December 2011, by cause of death. Also provided are the age-adjusted estimates of the number of deaths in the Era comparison group, crude mortality rate ratios and age-adjusted mortality rate ratios (RR) with their associated confidence intervals.
12. The 95% confidence interval for a rate provides the range of values within which we expect to find the real value of the indicator under study, with a probability of 95%. If the confidence interval for a rate does not include 1.00, the result is deemed to be statistically significant. Please see **Background notes** for more information about confidence intervals.
13. There were 1,283 deaths among the Gulf veterans up to 31 December 2011 and 1,364 deaths in the Era comparison group, representing increases of 90 and 112 respectively since the last release of this Statistical Notice in March 2011. These increases result in an estimate of 1,327 deaths in the age-adjusted Era comparison group.
14. There was no statistically significant difference between the total number of deaths among Gulf veterans (n=1,283) and the age-adjusted Era comparison group (n=1,327) (RR: 0.97, 95% CI: 0.89-1.04).

Table 1: Deaths among UK Gulf 1 veterans¹ by cause of death², 1 April 1991 - 31 December 2011, numbers and rate ratios

ICD Chapter	Cause of death	Adjusted ⁶			Crude	Adjusted ⁶	Adjusted ⁶	
		Gulf	Era	Era	Mortality Rate Ratio	Mortality Rate Ratio	95% Confidence Interval	
	All deaths	1,283	1,364	1,327	0.93	0.97	(0.89	1.04)
	All cause coded deaths	1,241	1,326	1,292	0.93	0.96	(0.89	1.04)
I - XVIII	Disease-related causes	738	857	825	0.85	0.90	(0.81	0.99)
I	Certain infectious and parasitic diseases	11	9	7	1.21	1.40	(0.55	3.56)
II	Neoplasms	325	370	356	0.87	0.92	(0.79	1.07)
V	Mental and behavioural disorders	18	26	24	0.69	0.76	(0.41	1.41)
VI	Diseases of the nervous system	25	38	36	0.65	0.70	(0.42	1.16)
IX	Diseases of the circulatory system	239	280	275	0.85	0.87	(0.73	1.04)
X	Diseases of the respiratory system	26	26	22	0.99	1.10	(0.62	1.96)
XI	Diseases of the digestive system	69	73	73	0.94	0.96	(0.69	1.33)
III, IV, XII - XVIII	All other disease related causes ³	25	35	31	0.71	0.77	(0.45	1.32)
XX	External causes of mortality	503	469	467	1.06	1.07	(0.94	1.22)
	Transport accidents:	208	178	179	1.16	1.15	(0.94	1.41)
	Land transport accident:	174	150	151	1.15	1.14	(0.92	1.43)
	Pedestrian	16	7	8	2.26	2.16	(0.89	5.25)
	Motorcycle rider	55	49	48	1.11	1.13	(0.76	1.67)
	Car occupant	50	44	45	1.13	1.11	(0.74	1.67)
	Other ⁴	53	50	50	1.05	1.04	(0.70	1.55)
	Water transport	5	3	4	1.65	1.50	(0.37	5.99)
	Air and space transport	29	25	25	1.15	1.17	(0.68	2.00)
	Other external causes of accidental injury:	84	89	86	0.93	0.95	(0.70	1.29)
	Falls	10	16	15	0.62	0.68	(0.31	1.50)
	Exposure to inanimate mechanical forces	18	17	18	1.05	0.97	(0.50	1.91)
	Accidental drowning and submersion and other accidental threats to breathing	12	13	13	0.91	0.87	(0.39	1.97)
	Accidental poisoning by and exposure to noxious substances	17	23	21	0.73	0.76	(0.39	1.48)
	Accidental exposure to other and unspecified factors	20	13	13	1.52	1.60	(0.78	3.28)
	Other	7	7	6	0.99	1.06	(0.36	3.13)
	Intentional self-harm and events of undetermined intent ⁵	189	170	169	1.10	1.11	(0.90	1.37)
	Assault	7	10	10	0.69	0.65	(0.24	1.74)
	Legal intervention and operations of war	7	10	11	0.69	0.73	(0.28	1.92)
	Sequelae of external causes of morbidity and mortality	0	2	1	-	-	-	-
	Deaths where the inquest has been adjourned	8	10					
	Other deaths for which cause data are not yet available	22	29					
	Overseas deaths for which cause data are not available	20	9					

1. Service and Ex-Service personnel only.
2. Causes have been coded to the World Health Organisation's International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10), 1992.
3. Includes cases with insufficient information on the death certificate to provide a known cause of death.
4. Under ICD-10 coding if the death certificate does not specifically mention the type of vehicle that was involved in the accident, the death is coded to "motor- or nonmotor vehicle accident, type of vehicle unspecified". There were 38 of these deaths among Gulf veterans compared to 35 in the Era group.
5. Includes both coroner-confirmed suicides and open verdict deaths in line with the definition used by the Office for National Statistics (ONS) in the publication of National Statistics.
6. Adjusted for the single years of age structure of the Gulf cohort at 1 January 1991.

15. **Figure 1** presents the main causes of death for both the Gulf and Era cohorts.

Disease-related causes

16. **Table 1** shows that the number of disease-related deaths among Gulf veterans was statistically significantly lower than in the age-adjusted Era comparison group, with 738 deaths compared with an estimate of 825 respectively (RR=0.90, 95% CI: 0.81-0.99). No statistically significant difference was found in the last release, therefore this finding will be monitored in subsequent reports to ascertain if the

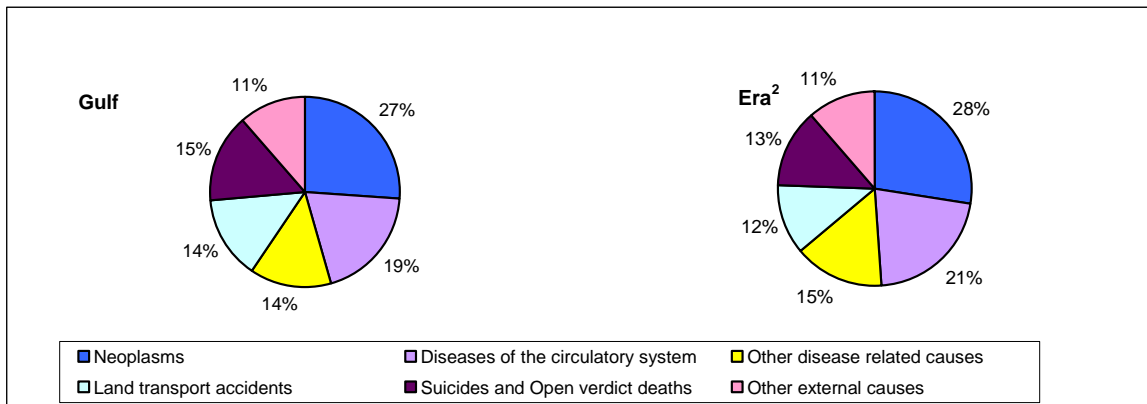
finding is real or has occurred by chance.

17. The main cause of disease-related deaths amongst both Gulf veterans and the age-adjusted Era comparison group was neoplasms: 325 deaths compared with an estimate of 356 respectively. There was no statistically significant difference between the number of deaths due to neoplasms in the two cohorts (RR: 0.92, 95% CI: 0.79-1.07). **Table 2** provides further details on the specific cancer sites.
18. There were 239 deaths due to diseases of the circulatory system (including ischaemic heart disease and cerebrovascular disease) among Gulf veterans compared with an estimate of 275 in the age-adjusted Era comparison group. There was no statistically significant difference between the number of deaths due to diseases of the circulatory system in the two cohorts (RR: 0.87, 95% CI: 0.73-1.04).
19. There were 5 deaths from motor neurone disease (MND) among Gulf veterans compared with an estimate of 10 in the age-adjusted Era comparison group. Deaths due to motor neurone disease have been separately identified as this cause of death has been of interest to Veterans groups external to the MOD.

External causes of mortality

20. **Table 1** shows that there was no statistically significant difference in the total number of deaths from external causes between Gulf veterans (n=503) and the age-adjusted Era comparison group (n=467) (RR: 1.07, 95% CI: 0.94-1.22).
21. The largest group of deaths due to external causes was transport accidents: 208 deaths among Gulf veterans compared with an estimate of 179 among the age-adjusted Era comparison group. Of these, land transport accidents accounted for 174 Gulf Veterans' deaths compared to an estimate of 151 in the Era cohort. Neither of these findings were statistically significant (**Table 1**).
22. There were 189 deaths due to intentional self-harm and events of undetermined intent (suicides and open verdict deaths) among Gulf veterans compared with an estimate of 169 among the age-adjusted Era comparison group, but this was not statistically significant (RR: 1.11, 95% CI: 0.90-1.37).

Figure 1: Deaths among UK Gulf veterans by main cause of death¹, 1 April 1991 - 31 December 2011, percentages



1. Percentages have been calculated using the total for all cause coded deaths.
2. Adjusted for the single years of age structure of the Gulf cohort at 1 January 1991.

23. **Table 2** provides the number of deaths due to neoplasms to personnel who deployed to the 1990/91 Gulf Conflict and the Era comparison group between 1 April 1991 and 31 December 2011, by cancer site. Also provided are the age-adjusted estimates of the number of deaths in the Era comparison group for each cancer site, crude mortality rate ratios and age-adjusted mortality rate ratios (RR) with their associated confidence intervals.
24. There were no statistically significant differences in the total number of deaths due to neoplasms between the Gulf veterans (n=325) and the age-adjusted Era comparison group (n=356) (RR: 0.92, 95% CI: 0.79-1.07).

25. However, the numbers of deaths within two of the specific cancer sites were statistically significantly lower among Gulf 1 veterans than in the Era comparison group:

- For malignant neoplasm of the colon there were 13 and 26 deaths respectively (RR: 0.51, 95% CI: 0.26-0.98);
- For malignant neoplasm of the bronchus and lung there were 39 and 62 deaths respectively (RR: 0.62, 95% CI: 0.42-0.93). Deaths due to MN of the bronchus and lung accounted for the majority of deaths within the major cancer site 'malignant neoplasm of the respiratory and intrathoracic organs'. Therefore the overall numbers of deaths for this major cancer site were also found to be statistically significantly lower among Gulf 1 veterans than in the Era comparison group, with 43 and 65 deaths respectively (RR: 0.66, 95% CI: 0.45-0.97).

These findings will continue to be monitored in subsequent reports to ascertain if they are real or have occurred by chance. (**Table 2**).

26. Please note that **Table 2** only presents specific cancer sites when there are five or more deaths in one of the cohorts. However deaths are monitored for all cancer sites e.g. within the major cancer site 'MN of genitourinary organs' three specific cancer sites are presented. Within this major site there are also a further six Gulf deaths and three Era deaths not specified due to numbers fewer than five.

Table 2: Deaths among UK Gulf veterans due to neoplasms, 1 April 1991 – 31 December 2011, numbers and rate ratios¹

Major cancer sites and specific sites with at least 5 deaths in one of the cohorts

ICD code	Cancer site	Gulf	Era	Adjusted ² Era	Crude	Adjusted ²	Adjusted ²	
					Mortality Rate Ratio	Mortality Rate Ratio	95% Confidence Interval	
C00-D48	Neoplasms	325	370	356	0.87	0.92	(0.79	1.07)
C00-C99	Malignant Neoplasms (MN)	321	365	351	0.87	0.92	(0.79	1.07)
C00-C14	MN of lip, oral cavity and pharynx	16	12	12	1.32	1.38	(0.65	2.95)
C15-C26, C48	MN of digestive organs and peritoneum	106	118	115	0.89	0.95	(0.73	1.24)
C15	MN of oesophagus	28	24	23	1.16	1.26	(0.74	2.16)
C16	MN of stomach	14	18	15	0.77	0.88	(0.43	1.80)
C18	MN of colon	13	29	26	0.44	0.51	(0.26	0.98)
C19	MN of rectosigmoid junction	5	2	2	2.48	2.38	(0.50	11.41)
C20	MN of rectum	9	7	7	1.27	1.31	(0.49	3.50)
C22	Malignant neoplasm of liver and intrahepatic bile ducts	8	8	9	0.99	1.01	(0.40	2.54)
C25	MN of pancreas	19	25	26	0.75	0.75	(0.41	1.36)
C26	MN of other and ill-defined digestive organs	6	3	3	1.98	1.89	(0.49	7.22)
C30-C39	MN of respiratory and intrathoracic organs	43	71	65	0.60	0.66	(0.45	0.97)
C34	MN of bronchus and lung	39	68	62	0.57	0.62	(0.42	0.93)
C40-C45, C47, C49-C50	MN of bone, connective tissue, skin and breast	29	32	32	0.90	0.91	(0.55	1.50)
C43	Malignant melanoma of skin	14	17	17	0.82	0.84	(0.42	1.70)
C45	Mesothelioma	2	6	7	0.33	0.35	(0.08	1.56)
C50	MN of breast	5	5	5	0.99	0.98	(0.27	3.48)
C51-C68	MN of genitourinary organs	32	24	23	1.32	1.44	(0.84	2.44)
C56	MN of ovary	5	2	2	2.48	2.44	(0.49	12.21)
C61	MN of prostate	8	9	9	0.88	1.09	(0.42	2.85)
C64	MN of kidney, except renal pelvis	13	10	11	1.29	1.25	(0.55	2.84)
C69-C80	MN of other and unspecified sites	52	69	67	0.75	0.76	(0.53	1.10)
C71	MN of brain	33	43	42	0.76	0.77	(0.49	1.22)
C80	MN without specification of site	14	21	20	0.66	0.68	(0.34	1.34)
C81-C96	MN of lymphatic and haematopoietic tissue	41	39	37	1.04	1.10	(0.70	1.71)
C81-C85, C91.4, C96	Lymphomas	20	22	22	0.90	0.94	(0.51	1.71)
C81	Hodgkin's disease	4	6	7	0.66	0.64	(0.18	2.22)
C82-C85, C91.4, C96	Non-Hodgkin's lymphoma	16	16	16	0.99	1.06	(0.53	2.11)
C91-C95 excl C91.4	Leukaemias	18	12	12	1.49	1.49	(0.71	3.13)
C92	Myeloid leukaemia	13	6	7	2.15	2.03	(0.78	5.24)
C97	Malignant neoplasms of independent (primary) multiple sites	2	0	0	-	-	-	-
D00-D48	In situ neoplasms, benign neoplasms and neoplasms of uncertain behaviour or unspecified nature	4	5	5	0.79	0.75	(0.19	3.01)

1. Where major cancer sites are not shown, there are no deaths within this group in either of the cohorts.

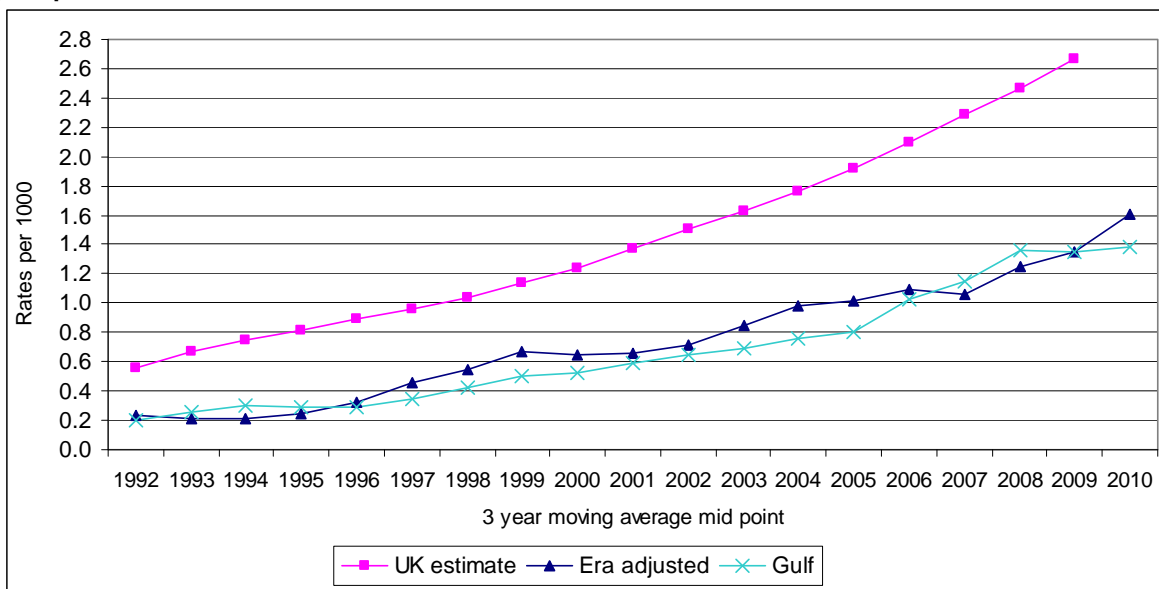
2. Adjusted for the single years of age structure of the Gulf cohort at 1 January 1991. The numbers may not add up to the totals shown due to rounding.

Comparison with UK General Population

Standardised Rates

27. UK general population mortality rates were applied to the age and gender profile of the Gulf cohort to estimate comparable mortality rates. There would have been an estimated 2,191 deaths among Gulf veterans if they had experienced the age and gender specific mortality rates of the UK general population, compared to the 1,283 deaths that have actually occurred between 1991 and 2011, thus there are fewer than expected deaths among Gulf 1 veterans than in the UK general population.
28. Mortality rates for disease-related causes for both Gulf veterans and the age-adjusted Era comparison group have gradually increased between 1991 and 2011 (**Figure 2**). These follow the trends in rates for disease-related causes among the UK general population. This suggests that the increase in disease-related deaths among Gulf veterans over time reflects the natural ageing of the cohort. However, the mortality rates due to disease-related causes for both Gulf veterans and the age-adjusted Era group are significantly lower than for the UK general population.

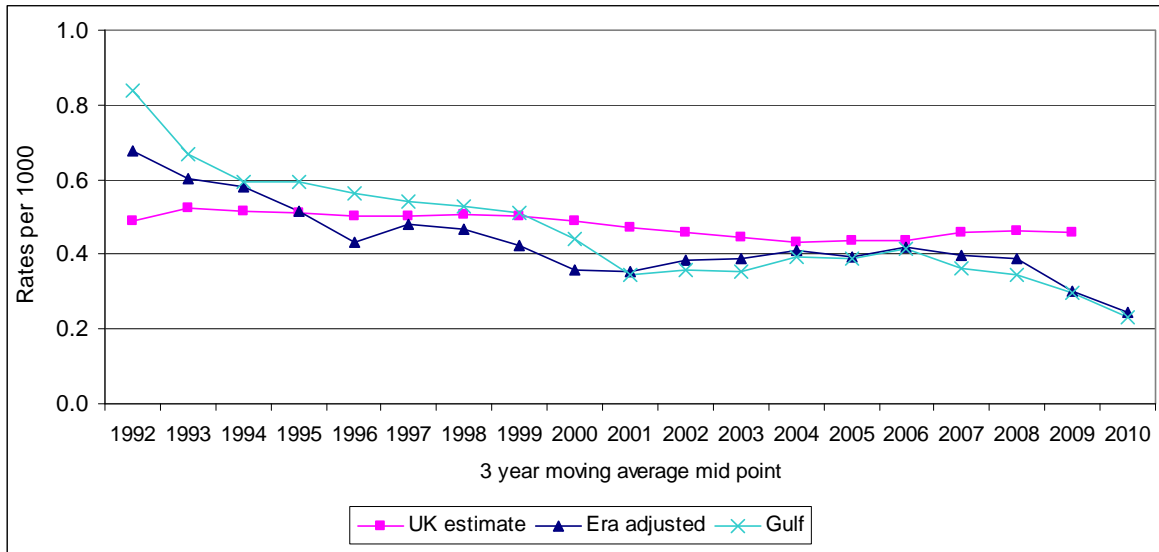
Figure 2: Gulf and Era mortality rates for disease related causes, 3-year moving average rates per 1,000 personnel^{1,2,3}



1. Data for 1 April 1991 – 31 December 1991 have been adjusted to a full year.
2. 2011 cause data for the UK general population are not currently available.
3. Mortality rates for the Era cohort have been adjusted for the single years of age structure of the Gulf cohort at 1 January 1991

29. Mortality rates for external causes of injury for both the Gulf veterans and the age-adjusted Era comparison group have decreased between 1991 and 2011 (**Figure 3**). However, comparable mortality rates for the UK general population have stayed constant during this period.

Figure 3: Gulf and Era mortality rates for external causes of mortality, 3-year moving average rates per 1,000 personnel^{1,2,3}



1. Data for 1 April 1991 – 31 December 1991 have been adjusted to a full year.
2. 2011 cause data for the UK general population are not currently available.
3. Mortality rates for the Era cohort have been adjusted for the single years of age structure of the Gulf cohort at 1 January 1991

Standardised Mortality Ratios (SMR)

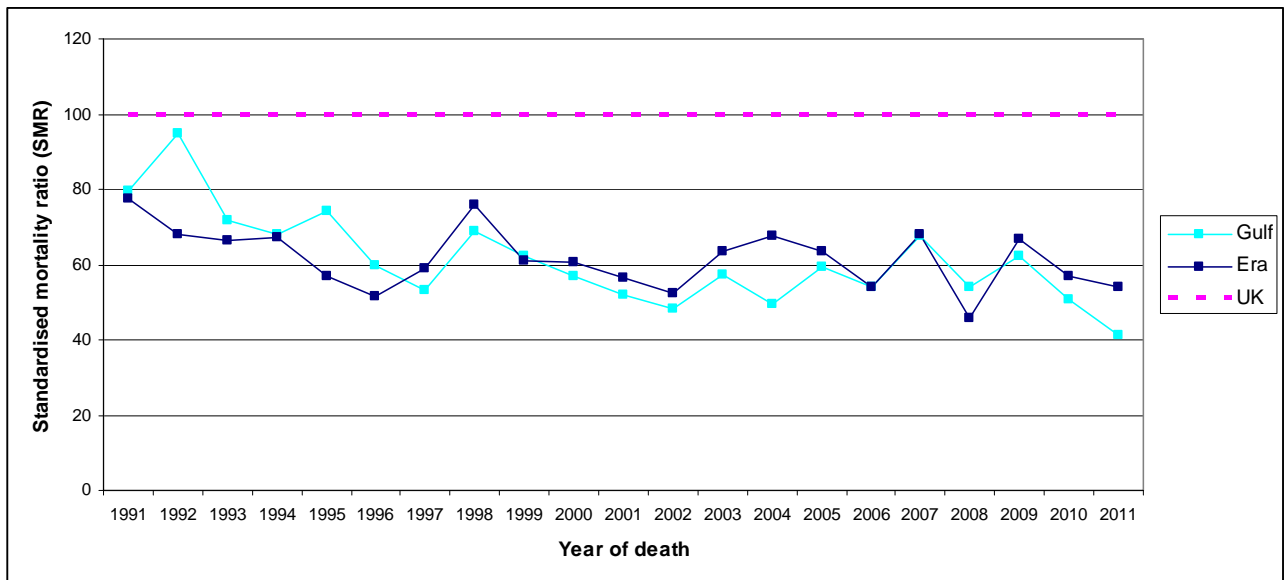
30. In order to compare deaths among the Gulf and Era cohorts with those among the UK population, Standardised Mortality Ratios (SMR) have been calculated for each cohort. The year on year changes in the UK population have been taken into account in these calculations. An SMR below, equal to, or above 100 indicates that the rate for the Gulf or Era cohort is respectively below, equal to, or higher than the rate in the UK population (see '**Statistical notes**' for further clarification).
31. The 95% confidence interval for a SMR provides the range of values within which we expect to find the real value of the indicator under study, with a probability of 95%. If the confidence interval for an SMR does not include 100, the result is deemed to be statistically significant.
32. Overall SMR were calculated for both the Gulf and Era cohorts covering all reported deaths from 1991 to 2011. The SMR showed that there was a statistically significant decreased risk of dying in both the Gulf (SMR=59, 95% CI:55-62) and Era (SMR=61, 95% CI:57-64) cohorts compared to the UK population (**Table 3**).
33. **Table 3** provides the SMR for each year from 1991 to 2011. These show that there was a statistically significant decreased risk of dying in the Gulf cohort for all years from 1993 to 2011, and in the Era cohort for all years from 1992 to 2011 compared to the UK population. The SMR for deaths during 2011 were 41 (n=75) in the Gulf cohort (95% CI: 33-52) and 54 (n=100) in the Era cohort (95% CI: 44-66).
34. **Figure 4** shows the variation in the SMR for the Gulf and Era cohorts each year compared to the UK population. The SMR for the Gulf and Era cohorts have decreased between 1991 and 2011 (from 80 to 41 in the Gulf cohort and 77 to 54 in the Era cohort). This shows that the gap in the risk of dying in both cohorts when compared to the UK general population, has widened over time.

Table 3: Deaths by year and cohort, 1991-2011, numbers, Standardised Mortality Ratios (SMR)¹ and 95% confidence intervals (CI)

Year	Gulf cohort			Era cohort		
	Number	SMR	(95% CI)	Number	SMR	(95% CI)
All years	1,283	59	(55 - 62)	1,364	61	(57 - 64)
1991	47	80	(60 - 106)	47	77	(58 - 103)
1992	57	95	(73 - 123)	42	68	(50 - 92)
1993	45	72	(54 - 96)	43	67	(49 - 90)
1994	45	68	(51 - 91)	46	67	(50 - 90)
1995	52	74	(57 - 97)	41	57	(42 - 77)
1996	44	60	(45 - 80)	39	51	(38 - 70)
1997	40	53	(39 - 72)	46	59	(44 - 79)
1998	56	69	(53 - 89)	64	76	(59 - 97)
1999	53	62	(47 - 81)	54	61	(47 - 80)
2000	51	57	(43 - 75)	56	61	(47 - 79)
2001	50	52	(39 - 69)	56	57	(44 - 74)
2002	49	48	(36 - 64)	55	52	(40 - 68)
2003	62	57	(45 - 74)	71	64	(50 - 80)
2004	56	50	(38 - 64)	79	68	(54 - 85)
2005	71	59	(47 - 75)	78	64	(51 - 79)
2006	71	54	(43 - 68)	73	54	(43 - 68)
2007	94	68	(55 - 83)	97	68	(56 - 83)
2008	81	54	(43 - 67)	71	46	(36 - 58)
2009	99	62	(51 - 76)	109	67	(55 - 81)
2010	85	51	(41 - 63)	97	57	(47 - 69)
2011	75	41	(33 - 52)	100	54	(44 - 66)

1. Standardised mortality ratios have been age and gender standardised

Figure 4: Deaths by year and cohort, 1991-2010, numbers, Standardised Mortality Ratios (SMR)



35. **Table 4** provides the SMR by five year age group for all deaths from 1991 to 2011. These show that there was a statistically significant decreased risk of dying in both the Gulf and Era cohorts for all age groups from 30-34 to 70+. For ages 29 and under there was no statistically significant difference in the risk of dying in the Gulf and Era cohorts, compared to the UK population.

36. **Figure 5** shows the variation in the SMR for the Gulf and Era cohorts for each five year age group, compared to the UK population. For those aged 24 and under, the SMR for the Gulf and Era cohorts were higher than for the UK population, however this increased risk was not statistically significant.

37. Overall, these comparisons show that the Gulf and Era cohorts have lower death rates than the UK general population. This may partially be explained by the 'healthy worker effect' often observed in occupational studies. This is deemed to occur when 'workers' are found to have lower mortality or other adverse health outcome rates than the general population due to the fact that certain groups of people are excluded from employment, particularly those who are ill or who have disabilities. This is to be expected in studies of Armed Forces mortality, as they are generally a highly selected group of individuals who are likely to have higher than usual levels of fitness and possibly lower levels of ill-health.

38. The next release of this Statistical Notice to be published in March 2013 will expand this section and include SMR by cause of death. This will enable the underlying reasons for the trends shown in Figures 4 and 5 to be explained. For example, the higher SMR in the younger age groups may be a result of higher numbers of injury related deaths in young Service personnel. Calculating SMR by cause of death will allow for further investigation of these differences.

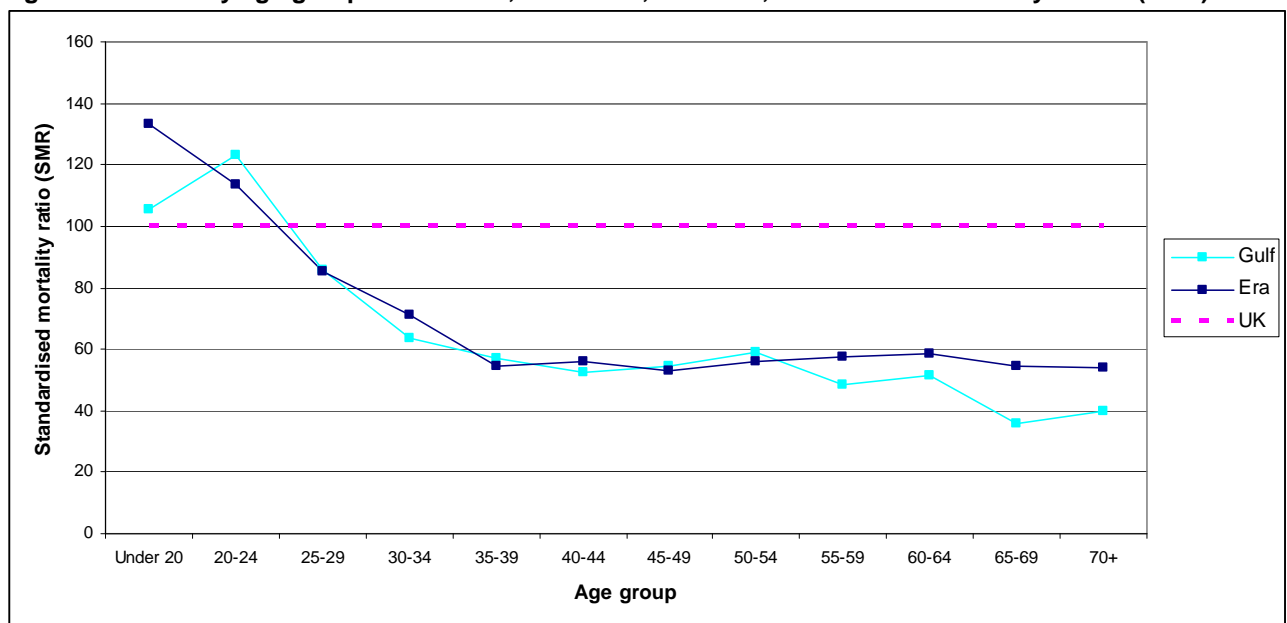
Table 4: Deaths by age group¹ and cohort, 1991-2011, numbers, Standardised Mortality Ratios (SMR)² and 95% confidence intervals (CI)

Age group	Gulf cohort			Era cohort		
	Number	SMR	(95% CI)	Number	SMR	(95% CI)
All ages	1,283	59	(55 - 62)	1,364	61	(57 - 64)
Under 20	3	106	(22 - 309)	8	133	(58 - 263)
20-24	78	123	(99 - 154)	71	113	(90 - 143)
25-29	122	86	(72 - 102)	119	85	(71 - 102)
30-34	139	64	(54 - 75)	153	71	(61 - 83)
35-39	180	57	(49 - 66)	168	55	(47 - 63)
40-44	199	53	(46 - 60)	207	56	(49 - 64)
45-49	186	54	(47 - 63)	179	53	(46 - 61)
50-54	170	59	(51 - 69)	160	56	(48 - 65)
55-59	102	48	(40 - 59)	125	57	(48 - 68)
60-64	67	51	(40 - 65)	84	59	(47 - 73)
65-69	24	36	(23 - 53)	53	55	(42 - 72)
70+	13	33	(21 - 68)	37	69	(39 - 74)

1. Age is as at date of death

2. Standardised mortality ratios have been age and gender standardised

Figure 5: Deaths by age group¹ and cohort, 1991-2010, numbers, Standardised Mortality Ratios (SMR)



1. Age is as at date of death

Background notes

39. Gulf veterans mortality data covering the period 1 April 1991 to 31 March 1999 were originally analysed by a team led by Professor Gary Macfarlane at the University of Manchester. The findings were published in Macfarlane G et al, Mortality of UK Gulf War Veterans, *The Lancet*, 2000; **356**:17-21. Updates have been regularly presented to Parliament by the MOD between July 2000 and July 2003, and published in Hansard in January and July of each year. Since January 2004 the updates have been released by DASA as a National Statistics notice with agreement by MOD ministers. These data can be found on the DASA website: www.dasa.mod.uk. Further analyses were published by Macfarlane GJ et al, Long-term mortality amongst Gulf War Veterans: is there a relationship with experiences during deployment and subsequent morbidity?, *Int J of Epi*, 2005; 34: 1403-1408.
40. Detailed analysis on the incidence of cancer among UK Gulf war veterans has been produced by Professor Gary Macfarlane and other researchers from University of Manchester, London School of Hygiene and Tropical Medicine and Kings College London. The findings were published in Macfarlane G et al, Incidence of cancer among UK Gulf veterans: cohort study, *BMJ*, 2003; **327**:1373-1376.

Glossary

41. **Gulf 1 veterans** consist of Service personnel deployed to any Gulf state between 1 September 1990 and 30 June 1991 and for the Navy afloat, all personnel aboard a ship East of the Suez canal during that period. The data do not include civilian personnel employed by the MOD (including the Royal Fleet Auxiliary, the NAAFI, MOD civil servants), by other Government Departments, or civilians working for Defence Contractors, the media or charitable and humanitarian organisations.
42. **The Era comparison group** comprises 53,143 personnel, randomly sampled from all UK Armed Forces personnel in Service on 1 January 1991 and who did not deploy to the Gulf. This group is stratified according to the 53,409 Gulf veterans to reflect the socio-demographic and military composition of the Gulf cohort in terms of age, gender, Service (Naval Service, Army, Royal Air Force), officer/other rank status, regular/reservist status, and a proxy measure for fitness. The single year age distribution among those aged 40 and over has since been found to show differences, with those in this age-group deployed to the Gulf generally younger than those in the Era group. Age adjusted estimates have been calculated using the methodology described below.

Data sources

43. The main source of information on the deaths described here is the NHS Information Centre for Health and Social Care (England and Wales) and the General Register Office (GRO) for Scotland. As at 31 December 2011, 100,189 individuals from the Gulf and Era cohorts remained flagged by one of the above organisations. In-Service deaths are sent to the ONS for independent coding. Coroners verdicts are provided by the NHS for deaths in England and Wales. For Scotland, accidental and violent deaths are investigated by the Procurator Fiscal.
44. DASA follows ONS guidelines for which deaths to include in each of the cause groups on **Table 1**. In December 2004 the ONS informed DASA they were now coding deaths where the inquest has been adjourned to the ICD-10 code Y33 ("Other specified events, undetermined intent"). In the releases of these statistics prior to January 2005 these deaths were included with the Intentional self-harm and events of undetermined intent.
45. The UK general population data for 2011 were not available for this report to calculate standardised mortality ratios (SMRs), therefore DASA has used the 2010 data as an estimate for the 2011 figures as there is little year on year variation for the UK figures. Thus, any patterns reported here may be subject to minor fluctuations when the 2011 data becomes available.

Statistical methods

46. The mortality rate ratios provided here were calculated using as denominator the total person-years at risk (the length of time each person has been in study), taking into account deaths and emigrations from the UK. People who had left the Services and subsequently emigrated were deemed to be lost to follow up because we had no means of knowing if and when they may have died. The mortality rate ratios given here differ marginally from the crude deaths ratio owing to some small differences in the number of person years at risk between the Gulf and Era comparison groups.

47. The 95% confidence interval provides the range of values within which we expect to find the real underlying value of the study indicator, with a probability of 95%. If the confidence interval does not include 1.00, the result is deemed to be statistically significant. Note that confidence intervals have been provided due to imprecision that arises, not as a result of sampling variation, but due to the 'natural' variation in Gulf and Era deaths. For the SMR calculations, it is the underlying difference between the Gulf and Era cohorts and the UK population that is of interest and the actual values observed in any one time period only give an imprecise estimate of this 'underlying risk'.
48. Age-adjusted estimated numbers for the Era comparison group were created by calculating the mortality rate for each single year of age at 1 January 1991 in each calendar year since 1991. This rate was applied to the equivalent numbers in each single year of age at 1 January 1991 and year of death in the Gulf population, from which deaths and emigrations from the UK were subtracted, to calculate the estimated total for each calendar year. These estimated numbers by calendar year were divided by the Gulf population, from which deaths and emigrations from the UK were subtracted, to produce the adjusted rate for **Figures 2 and 3**.
49. To enable comparisons with the UK general population, UK mortality rates have been calculated based on deaths and population data provided by the Office for National Statistics (for England and Wales), General Register Office (for Scotland) and Northern Ireland Statistics and Research Agency (for Northern Ireland). These UK mortality rates were applied to the age and gender profile of the Gulf cohort to estimate comparable mortality rates for disease related deaths and deaths due to external causes (see Figures 2 and 3). The UK deaths data were also applied to the Gulf cohort to calculate the expected number of deaths in a similar sized cohort taken from the general UK population with the same age and gender profile as that of the Gulf cohort (see para 6).
50. To enable statistical comparisons with deaths in the UK population, Standardised Mortality Ratios (SMR), adjusted for age, gender and year, were calculated. An SMR is defined as the ratio of the number of deaths *observed* in the study population to the number of deaths *expected* if the study population had the same age- and gender-specific rates as the standard population in each specific year, multiplied by 100 by convention. An SMR over (or under) 100 indicates a higher (or lower) number of observed deaths than expected (based on standard population rates). An SMR of 100 implies that there is no difference in rates when comparing the Gulf and Era cohorts with the UK population.

Data quality

51. Information on deaths in Northern Ireland was routinely notified through GRO for Scotland. However, the Central Services Agency now produce all coded death information for medical research in Northern Ireland. It is hoped that DASA will be able to receive regular updates in line with England and Wales, and Scotland in the near future for Northern Ireland to improve the timeliness of information on flagged individuals in Northern Ireland.
52. Previous versions of this report (prior to March 2008) were produced bi-annually with a 2 week allowance for analysing the data. Owing to the continued consistency of the findings and following consultation with key stakeholders, the publication of this report, and of future updates, has moved to an annual basis with a 3-month allowance for the time lags in the delivery of administrative data (publication by end March). This ensures greater accuracy of the information provided for the latest 12-month period.
53. Several findings in this Statistical Notice are based on small numbers. This is evidenced by the wide range of several confidence intervals presented in this report. We strongly recommend caution when interpreting these figures.
54. The findings presented in this notice are broadly similar to results published in March 2011 covering deaths during the period 1 April 1991 to 31 December 2010. Where differences have been found, such as the statistically significant findings noted in the Key Points, the findings will be monitored in future releases.

Revisions

55. The figures presented in this Statistical Notice are from deaths reported to the Ministry of Defence (MOD) by 10 February 2012. Further deaths for the period 1 April 1991 to 31 December 2011 may be reported to the MOD before publication of the next release, in March 2013. As the information presented in each release of this is from a snapshot of data received by a certain date, these are not classified as revisions.
56. If errors are found in the classifications or statistical methods used during the production of this report which result in changes to published statistics, these will be corrected and the Statistical Notice republished.