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

Introduction

1. This 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 2010. The mortality rates of 53,409 UK Gulf veterans were analysed alongside those of a comparison group, the Era cohort. The Era comparison group 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.
2. The findings include those who died while in Service and those who died after they had left the Services. The statistics are based on deaths reported to the Ministry of Defence (MOD) up to 31 December 2010, updating the previous notice for deaths reported up to 31 December 2009 released on 31 March 2010. Further information on deaths that may have occurred during the period 1 April 1991 to 31 December 2010, reported to the MOD after the release of this publication, will be added to future publications.
3. 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 aged 40 and above in the Gulf and the Era cohort.
4. 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.

Key Points

5. There were 1,193 deaths among the Gulf veterans up to 31 December 2010 and 1,252 deaths in the Era comparison group, representing increases of 98 and 107 respectively since the last release in March 2010, resulting in an estimate of 1,216 deaths in the age-adjusted Era comparison group.
6. UK general population mortality rates were applied to the age and gender profile of the Gulf cohort to estimate comparable mortality rates. The 1,193 deaths among Gulf veterans compare with approximately 1,998 deaths in the UK general population (see paragraph 27 for details).
7. There were no statistically significant differences in the total number of deaths between the Gulf veterans and the Era comparison group, or for any of the main groups of cause of death.
8. There were fewer disease-related deaths among the Gulf veterans than the age-adjusted Era comparison group: 668 deaths compared with an estimate of 736. This result is not statistically significant and no statistically significant difference has been found between these groups in releases since July 2007. This supports the assumption that the statistically significant finding in the July 2007 publication was due to chance.

Other findings

9. The following points show further comparisons between the Gulf veterans and the age-adjusted Era comparison group. None of these findings are statistically significant.
10. **Table 1** shows the main cause of disease-related deaths amongst both Gulf veterans and the age-adjusted Era comparison group were neoplasms: 297 deaths compared with an estimate of 311. **Table 2** provides further details on the specific cancer sites.
11. There were 219 deaths due to diseases of the circulatory system (including ischaemic heart disease and cerebrovascular disease) among Gulf veterans compared with an estimate of 244 in the age-adjusted Era comparison group.
12. There were 5 deaths from motor neurone disease among Gulf veterans compared with an estimate of 9 in the age-adjusted Era comparison group.
13. There were more deaths due to external causes among Gulf veterans than the age-adjusted Era comparison group, but this was not statistically significant: 488 deaths compared with an estimate of 453.
14. The largest group of deaths due to external causes was transport accidents: 202 deaths among Gulf veterans compared with an estimate of 177^f among the age-adjusted Era comparison group. Of these, land transport accidents accounted for 168 Gulf Veterans' deaths compared to an estimate of 149^f.
15. There were 183 deaths due to intentional self-harm and events of undetermined intent (suicides and open verdict deaths) among Gulf veterans compared with an estimate of 163 among the age-adjusted Era comparison group, but this was not statistically significant.
16. Mortality rates for disease-related causes for both Gulf veterans and the age-adjusted Era comparison group have gradually increased between 1991 and 2010 (**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.
17. Mortality rates for external causes of injury for both the Gulf veterans and the age-adjusted Era comparison group have decreased between 1991 and 2010 (**Figure 3**). However, comparable mortality rates for the UK general population have stayed constant during this period.

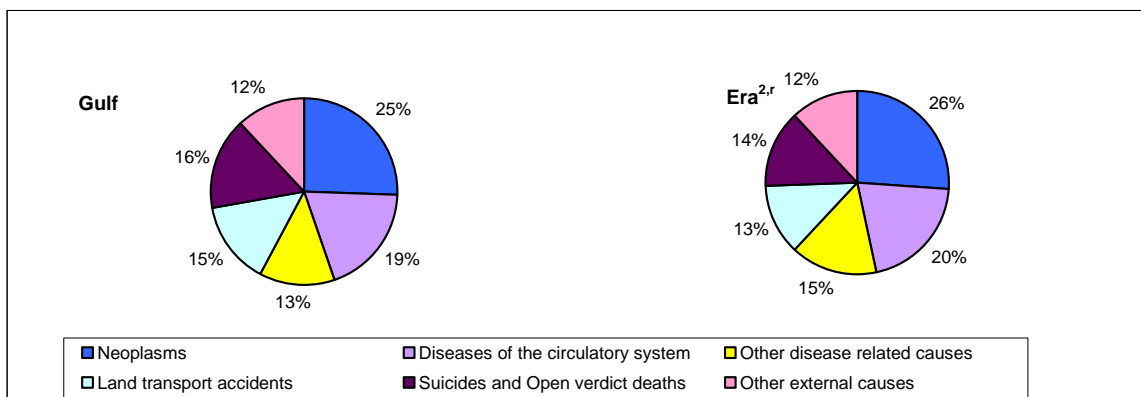
Table 1: Deaths among UK Gulf 1 veterans¹ by cause of death², 1 April 1991 - 31 December 2010, numbers and rate ratios

ICD Chapter	Cause of death	Gulf	Era	Adjusted ⁶	Crude	Adjusted ⁶	Adjusted ⁶
				Era	Mortality	Mortality	95% Confidence
				Rate Ratio	Rate Ratio	Rate Ratio	Interval
	All deaths	1,193	1,252	1,216	0.94	0.98	(0.90 1.06)
	All cause coded deaths	1,156	1,223	1,189	0.94	0.97	(0.89 1.05)
I - XVIII	Disease-related causes	668	765	736	0.87	0.91	(0.82 1.01)
I	Certain infectious and parasitic diseases	10	9	7	1.10	1.27	(0.49 3.31)
II	Neoplasms	297	326	311	0.90	0.96	(0.82 1.12)
V	Mental and behavioural disorders	17	26	24	0.65	0.71	(0.38 1.33)
VI	Diseases of the nervous system	21	35	33	0.59	0.65	(0.37 1.11)
IX	Diseases of the circulatory system	219	249	244	0.87	0.90	(0.75 1.08)
X	Diseases of the respiratory system	25	21	19	1.18	1.28	(0.69 2.36)
XI	Diseases of the digestive system	58	67	67	0.86	0.88	(0.62 1.25)
III, IV, XII - XVIII	All other disease related causes ³	21	32	28	0.65	0.72	(0.40 1.28)
XX	External causes of mortality	488	458	453	1.06	1.07	(0.94 1.21)
	Transport accidents:	202	175 ^r	177 ^r	1.14 ^r	1.13 ^r	(0.92 ^r 1.39) ^r
	Land transport accident:	168	147 ^r	149 ^r	1.13 ^r	1.12 ^r	(0.89 ^r 1.40) ^r
	Pedestrian	17	7	8	2.41	2.26	(0.93 5.49)
	Motorcycle rider	53	47	47	1.12	1.11	(0.75 1.66)
	Car occupant	48	43 ^r	44 ^r	1.11 ^r	1.09 ^r	(0.72 ^r 1.65) ^r
	Other ⁴	50	50	50	0.99	0.99	(0.66 1.47)
	Water transport	5	3	4	1.65	1.50	(0.37 5.99)
	Air and space transport	29	25	25	1.15	1.17	(0.69 2.00)
	Other external causes of accidental injury:	81	88 ^r	85 ^r	0.91 ^r	0.93 ^r	(0.68 ^r 1.27) ^r
	Falls	9	15	14	0.59	0.66	(0.29 1.49)
	Exposure to inanimate mechanical forces	18	18	19	0.99	0.92	(0.47 1.79)
	Accidental drowning and submersion and other accidental threats to breathing	12	12	11	0.99	0.97	(0.42 2.24)
	Accidental poisoning by and exposure to noxious substances	17	22	20	0.77	0.80	(0.41 1.57)
	Accidental exposure to other and unspecified factors	18	13	13	1.37	1.47	(0.71 3.03)
	Other	7	8 ^r	8 ^r	0.87 ^r	0.91 ^r	(0.32 ^r 2.56) ^r
	Intentional self-harm and events of undetermined intent ⁵	183	164	163	1.11	1.12	(0.91 1.39)
	Assault	7	10	10	0.69	0.65	(0.24 1.74)
	Legal intervention and operations of war	7 ^r	10	11	0.69 ^r	0.73 ^r	(0.28 ^r 1.92) ^r
	Sequelae of external causes of morbidity and mortality	0	2	1	-	-	-
	Deaths where the inquest has been adjourned	8	9				
	Other deaths for which cause data are not yet available	17	20				
	Overseas deaths for which cause data are not available	20	9				

Notes:

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.

Figure 1: Deaths among UK Gulf veterans by main cause of death¹, 1 April 1991 - 31 December 2010, percentages



Notes:

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.

Table 2: Deaths among UK Gulf veterans due to neoplasms, 1 April 1991 – 31 December 2010, numbers and rate ratios

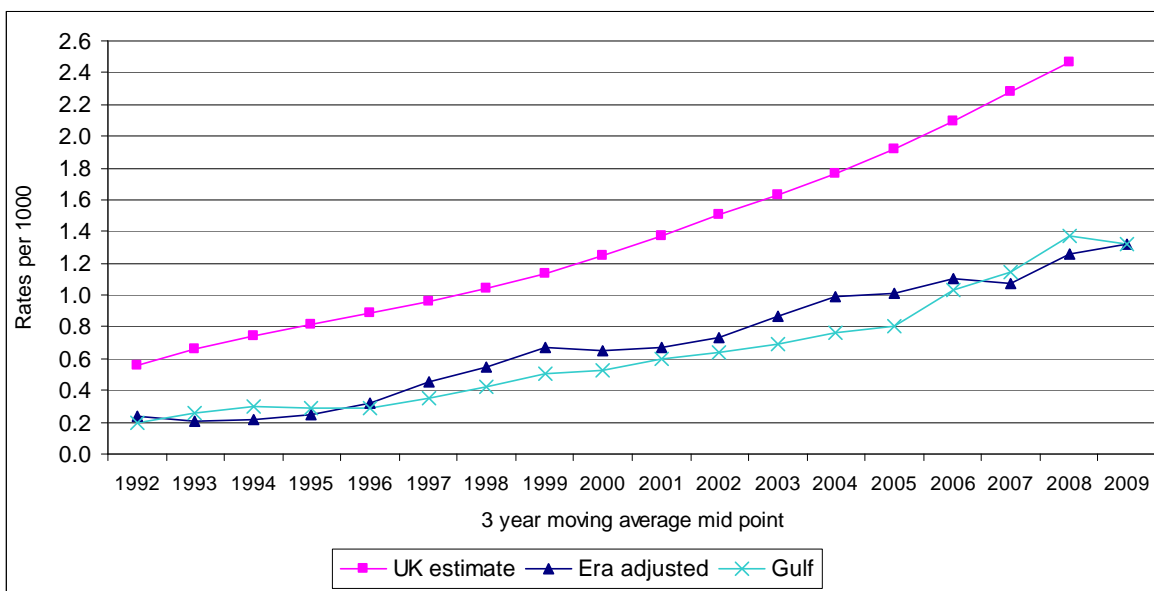
Major cancer sites and specific sites with at least 5 deaths in one of the cohorts

ICD code	Cancer site	Gulf	Era	Adjusted ¹ Era	Crude	Adjusted ¹	Adjusted ¹
					Mortality Rate Ratio	Mortality Rate Ratio	95% Confidence Interval
C00-D48	Neoplasms	297	326	311	0.90	0.96	(0.82 1.12)
C00-C99	Malignant Neoplasms (MN)	294	322	307	0.90	0.96	(0.82 1.13)
C00-C14	MN of lip, oral cavity and pharynx	11	10	9	1.09	1.14	(0.47 2.77)
C15-C26, C48	MN of digestive organs and peritoneum	100	99	94	1.00	1.08	(0.82 1.43)
C15	MN of oesophagus	25	22	21	1.13	1.23	(0.70 2.16)
C16	MN of stomach	13	14	12	0.92	1.06	(0.49 2.31)
C18	MN of colon	13	24	20	0.54	0.63	(0.32 1.27)
C19	MN of rectosigmoid junction	5	0	0	-	-	- -
C20	MN of rectum	8	7	7	1.13	1.18	(0.43 3.21)
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	19	19	0.99	1.00	(0.53 1.90)
C26	MN of other and ill-defined digestive organs	5	3	3	1.65	1.58	(0.39 6.29)
C30-C39	MN of respiratory and intrathoracic organs	41	62	58	0.66	0.72	(0.49 1.07)
C34	MN of bronchus and lung	37	59	54	0.62	0.68	(0.45 1.03)
C40-C45, C47, C49-C50	MN of bone, connective tissue, skin and breast	27	29	29	0.92	0.93	(0.55 1.57)
C43	Malignant melanoma of skin	13	15	15	0.86	0.88	(0.42 1.84)
C45	Mesothelioma	1	5	5	0.20	0.21	(0.03 1.60)
C50	MN of breast	5	5	5	0.99	0.98	(0.27 3.48)
C51-C68	MN of genitourinary organs	30	20	19	1.49	1.63	(0.93 2.88)
C56	MN of ovary	5	2	2	2.48	2.44	(0.49 12.22)
C61	MN of prostate	7	8	9	0.87	1.11	(0.41 3.04)
C64	MN of kidney, except renal pelvis	12	8	8	1.49	1.45	(0.59 3.53)
C69-C80	MN of other and unspecified sites	47	66	63	0.71	0.72	(0.49 1.05)
C71	MN of brain	30	41	39	0.73	0.74	(0.46 1.20)
C80	MN without specification of site	13	20	19	0.64	0.66	(0.33 1.33)
C81-C96	MN of lymphatic and haematopoietic tissue	36	36	35	0.99	1.04	(0.65 1.65)
C81-C85, C91.4, C96	Lymphomas	17	20	20	0.84	0.86	(0.45 1.63)
C81	Hodgkin's disease	4	6	6	0.66	0.64	(0.18 2.22)
C82-C85, C91.4, C96	Non-Hodgkin's lymphoma	13	14	14	0.92	0.96	(0.45 2.04)
C91-C95 excl C91.4	Leukaemias	17	12	12	1.40	1.41	(0.66 2.99)
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	3	4	4	0.74	0.66	(0.13 3.26)

Note:

1. 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.

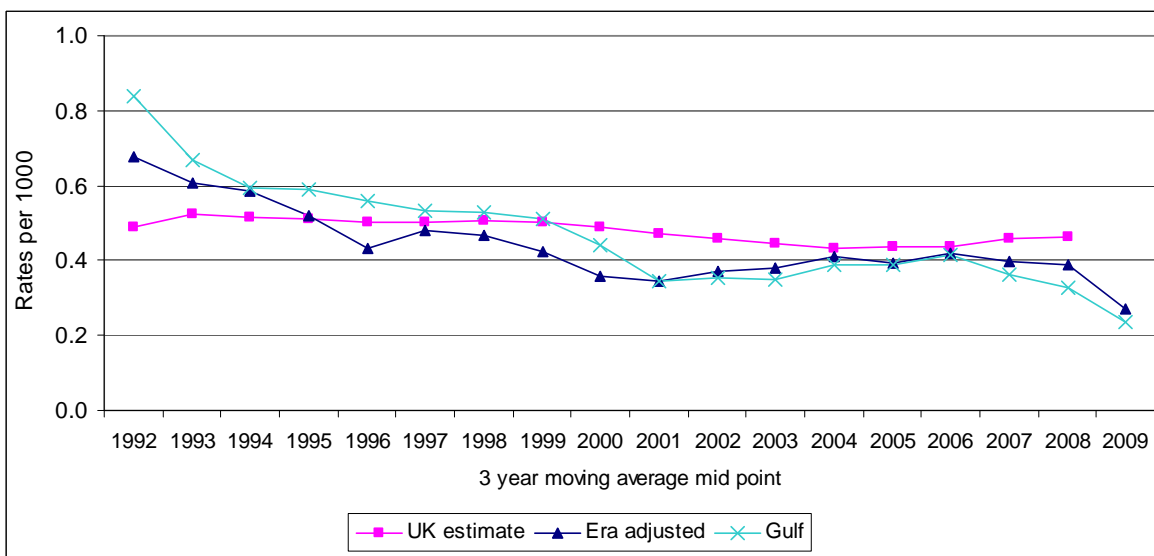
Figure 2: Gulf and Era mortality rates for disease related causes, 3-year moving average rates per 1,000 personnel^{1,2,3}



Notes:

1. Data for 1 April 1991 – 31 December 1991 have been adjusted to a full year.
2. 2010 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

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



Notes:

1. Data for 1 April 1991 – 31 December 1991 have been adjusted to a full year.
2. 2010 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

Background notes

18. 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.
19. The Era 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.
20. 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. 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. As at 31 December 2010, 100,333 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.
21. 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.
22. 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.
23. 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.

Statistical notes

24. 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.
25. The 95% confidence interval 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 does not include 1.00, the result is deemed to be statistically significant.
26. 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**.
27. 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).