

# The Human Cost of the War in Iraq

A Mortality Study, 2002-2006

Bloomberg School of Public Health  
Johns Hopkins University  
Baltimore, Maryland

School of Medicine  
Al Mustansiriya University  
Baghdad, Iraq

*in cooperation with the*

Center for International Studies  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

*principal authors*

Gilbert Burnham  
Shannon Doocy  
Elizabeth Dzeng  
Riyadh Lafta  
Les Roberts

# Summary

A new household survey of Iraq has found that approximately 600,000 people have been killed in the violence of the war that began with the U.S. invasion in March 2003.

The survey was conducted by an American and Iraqi team of public health researchers. Data were collected by Iraqi medical doctors with analysis conducted by faculty of the Johns Hopkins School of Public Health. The results will be published in the British medical journal, *The Lancet*.

The survey is the only population-based assessment of fatalities in Iraq during the war. The method, a survey of more than 1,800 households randomly selected in clusters that represent Iraq's population, is a standard tool of epidemiology and is used by the U.S. Government and many other agencies.

The survey also reflects growing sectarian violence, a steep rise in deaths by gunshots, and very high mortality among young men. An additional 53,000 deaths due to non-violent causes were estimated to have occurred above the pre-invasion mortality rate, most of them in recent months, suggesting a worsening of health status and access to health care.

## Methods

Between May and July 2006 a national cluster survey was conducted in Iraq to assess deaths occurring during the period from January 1, 2002, through the time of survey in 2006. Information on deaths from 1,849 households containing 12,801 persons was collected. This survey followed a similar but smaller survey conducted in Iraq in 2004. Both surveys used standard methods for estimating deaths in conflict situations, using population-based methods.

## Key Findings

Death rates were 5.5/1,000/year pre-invasion, and overall, 13.2/1,000/year for the 40 months post-invasion. We estimate that through July 2006, there have been 654,965 "excess deaths"—fatalities above the pre-invasion death rate—in Iraq as a consequence of the war. Of post-invasion deaths, 601,027 were due to violent causes. Non-violent deaths rose above the pre-invasion level only in 2006. Since March 2003, an additional 2.5% of Iraq's population have died above what would have occurred without conflict.

The proportion of deaths ascribed to coalition forces has diminished in 2006, though the actual numbers have increased each year. Gunfire remains the most common reason for death, though deaths from car bombing have increased from 2005. Those killed are predominantly males aged 15-44 years.

# Contents

Introduction	3
Methods	3
Survey Findings	5
Conclusion	10
References	11

## Appendices

A. Measuring Deaths in a Population: The Cluster Survey Method	A-1
B. Collecting the Data	A-3
C. Other Accounts of Mortality in Iraq	A-4
D. U.S. Military Casualties and Deaths and Their Long-Term Consequences	A-6
E. Health in Iraq	A-8
F. How Are So Many Fatalities Possible?	A-10
G. Policy Implications of High Mortality	A-11
References in Appendices	A-12

## Tables and Figures

Table 1. Province populations and cluster allocation	4
Table 2. Sources of violent deaths	7
Figure 1. Mortality rates in Iraq, 2002-2006	5
Figure 2. Death rates due to violent causes by governorates	7
Figure 3. Deaths in Iraq by cause and time period	8
Figure 4. Deaths by age and sex	9
Figure 5. Trend lines of different mortality accounts	A-5
Figure 6. Cumulative U.S. Military Deaths since March 2003	A-7
Figure 7. Cumulative U.S. Military non-fatal Casualties since March 2003	A-7
Figure 8. Infant and child mortality rates in Iraq	A-9

# Introduction

The March 2003 invasion of Iraq led by the United States was conducted with anticipation of a rapid and decisive victory. Along with these dashed expectations is the growing human cost of the war. Details on coalition casualties are readily available, and are summarized below. Controversy and uncertainty surround the number of Iraqis killed by continuing actions by coalition forces and by the escalating sectarian and criminal violence. Many reports have been circulated based on mortuary tallies, reports from the coalition, and news media accounts.<sup>1,2</sup> These reports provide a picture of escalating violence in the areas from which the information is collected. Such methods can provide important information on the types of fatal injuries and trends. It is not possible, however, to use these methods to estimate the burden of conflict on an entire population. Only population-based survey methods can estimate deaths for an entire country.

Fortunately, methods exist to make these types of estimates for an entire population. There have been on-going efforts to further refine these methods for use in conflict situations, supported by the U.S. and Canadian governments and United Nations agencies.<sup>3</sup>

Using these established methods, we conducted a survey in 2004 that estimated 100,000 excess civilian deaths had occurred following the March 2003 invasion by coalition forces.<sup>4</sup> As the war has continued unabated and as sectarian violence has escalated, it is likely that the death rate due to violence would have changed.<sup>5</sup> In late 2005, we began plans to repeat the survey during 2006. The actual timing of the survey was determined by various university administrative processes and field requirements.

The goal of the survey was to measure excess deaths that could be ascribed to the on-going conflict. The term “excess deaths” describes the death rates and the number of persons dying above what would normally have been expected had the war not occurred. The normal or expected death rate was based on survey results in the period from January 1, 2002, until March 2003. This can also be considered a “baseline” death rate. In these two surveys, the expected or baseline death rate we found pre-invasion, and which we will use as the basis of this report, is very similar to estimates of the U.S. Census Bureau and the U.S. Central Intelligence Agency.<sup>6,7</sup>

## Methods

The surveyors from the School of Medicine of Al Mustansirya University in Baghdad conducted a national survey between May and July 2006. In this survey, sites were collected according to the population size and the geographic distribution in Iraq. The survey included 16 of the 18 governorates in Iraq, with larger population areas having more sample sites. The sites were selected entirely at random, so all households had an equal chance of being included. The survey used a standard cluster survey method, which is a recommended method for measuring deaths in conflict situations. The survey team visited 50 randomly selected sites in Iraq, and at each site interviewed 40 households about deaths which had occurred from January 1, 2002, until the date of the interview in July 2006. We selected this time frame to compare results with our previous survey, which covered the period between January 2002 and September 2004. In all, information was collected from 1,849 households completing the survey, containing 12,801 persons. This sample size was selected to be able to statistically detect death rates with 95% probability of obtaining the correct result. When the preliminary results were reviewed, it was apparent that three clusters were misattributed. These were dropped from the data for analysis, giving a final total of 47 clusters, which are the basis of this study.

## Selection of the sites

Selection of households to be interviewed must be completely random to be sure the results are free of bias. For this survey, all households had an equal chance of being selected. A series of completely random choices were made. First the location of each of the 50 clusters was chosen according to the geographic distribution of the population in Iraq. This is known as the first stage of sampling in which the governorates (provinces) where the survey would be conducted were selected. This sampling process went on randomly to select the town (or section of the town), the neighborhood, and then the actual house where the survey

would start. This was all done using random numbers. Once the start house was selected, an interview was conducted there and then in the next 39 nearest houses. The distribution of the sample sites or clusters is shown in Table 1, which is based on the 2004 UNDP/Iraqi Ministry of Planning population estimates.<sup>8</sup>

**Table 1: Province populations and cluster allocation\***

<i>Province</i>	<i>Mid-year 2004 population</i>	<i>Number of clusters</i>
Baghdad	6,500,000	12
Ninewa	2,521,300	5
Basrah	1,981,900	3
Sulamaniyah	1,605,600	3
Thi-Qar	1,538,900	3
Babylon	1,408,700	3
Erbil	1,334,200	3
Diyala	1,271,300	3
Anbar	1,271,000	3
Salah Al-Din	976,100	2
Najaf	950,200	2
Wassit	938,700	1
Qadissiya	915,600	1
Tameem	881,500	1
Missan	848,300	1
Dahuk	817,400	0
Kerbala	741,700	1
Muthanna	569,900	0
<b>Total</b>	<b>27,072,200</b>	<b>47</b>

*\*excludes 3 clusters misattributed by the survey team*

## Conduct of the survey

The two survey teams consisted of two females and two males, each with one male supervisor. All were medical doctors with previous survey and community medicine experience and were fluent in English and Arabic. All were Iraqis. All were trained in the use of the questionnaire. Rules were established about how to randomly choose another area if the first one chosen was unsafe on the day of the survey visit.

In each cluster, queries were made about any household that had been present during the survey period that had ceased to exist because all members had died or left. This was done to judge the degree of “survivor bias” where only the households still “alive” could report.

The survey was explained to the head of household or spouse, and their consent to participate was obtained. For ethical reasons, no names were written down, and no incentives were provided to participate. The survey listed current household members by sex, asked about births, deaths, and migrations into and out of the household since 1 January 2002. (For more information on the survey methods and collection of data, see Appendix A and Appendix B.)

Deaths were recorded only if the person dying had lived in the household continuously for three months before the event. In cases of death, additional questions were asked in order to establish the cause and circumstances of deaths (while considering family sensitivities). At the conclusion of the interview in a household where a death was reported, the interviewers were to ask for a copy of the death certificate. In 92% of instances when this was asked, a death certificate was present.

## Data Analysis

Period mortality rates were calculated based on mid-interval population and with regression models. The numbers of excess deaths (attributable rates) were estimated by subtracting the predicted values for the pre-war mortality rates from the post-invasion mortality rates in the three post-invasion periods. Mortality projections were applied to the 2004 mid-year population estimates (26,112,353) of the surveyed areas (which exclude the governates of Muthanna and Dahuk, which had been omitted through misattribution<sup>9</sup>) to establish the mortality projections.

The study received ethical approval from the Committee on Human Research of the Johns Hopkins Bloomberg School of Public Health, and the School of Medicine, Al Mustansiriya University, Baghdad.

## Survey Findings

Among the 12,801 persons included in the survey, there were 1,474 births and 629 deaths reported in the period from January 2002 through June 2006.

### Death rates

Deaths reported were converted to rates, that is, the number of deaths occurring for every 1,000 persons in a year. The death rate is made up of all the deaths from all causes is called the crude death rate. In the period between January 2002 and the time of the invasion (March 2003), the 2006 survey found the crude death rate was found to be 5.5 deaths per 1,000 persons each year. This number is very close the figure determined by the U.S. Census Bureau, and the number quoted by the CIA. In the 2004 survey, we found this figure to be 5.0 deaths/1,000/year, a figure that is very similar.

### Crude mortality rates

For the purpose of analysis, the 40 months of survey data were divided into three equal periods—March 2003 to April 2004; May 2004 to May 2005, and June 2005 to June 2006. Following the invasion the death rate rose each year.

- Pre-invasion: 5.5 deaths/1,000/year
- March 2003-April 2004: 7.5 deaths/1,000/year
- May 2004-May 2005: 10.9 deaths/1,000/year
- June 2005-June 2006: 19.8 deaths/1,000/year
- Overall post-invasion: 13.2 deaths/1,000/year

These and other death rates from the study data are shown in Figure 1.

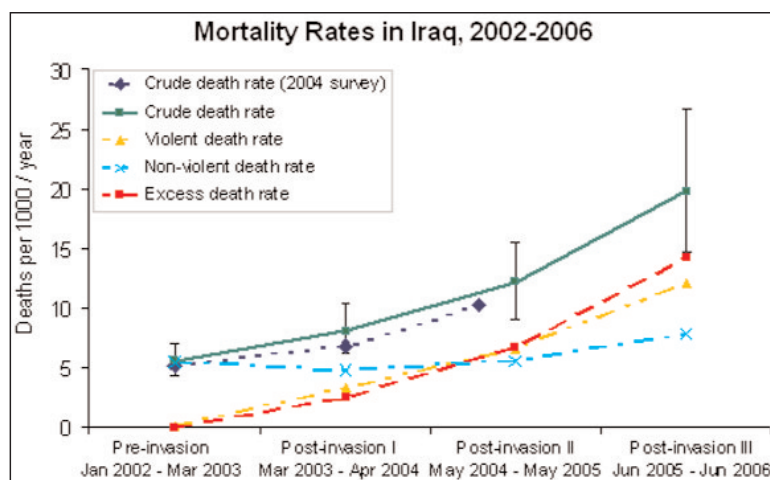


Figure 1.

## Excess death rate

The rate of 5.5 deaths/1,000/year will be considered as the “baseline” crude death rate, making the assumption that without conflict this rate would have continued at this level up to the present time, or even dropped somewhat (most likely). On the graph, the number of excess deaths is shown with the red line. The post-invasion excess death rate was:

- March 2003–April 2004: 2.6 deaths/1,000/year
- May 2004–May 2005: 5.6 deaths/1,000/year
- June 2005–June 2006: 14.2 deaths/1,000/year
- Overall post-invasion: 7.8 deaths/1,000/year

## Violent death rates

As there were few violent deaths in the survey population prior to the invasion, all violent deaths can be considered “violent excess deaths.” The post-invasion violent death rate was:

- March 2003–April 2004: 3.2 deaths/1,000/year
- May 2004–May 2005: 6.6 deaths/1,000/year
- June 2005–June 2006: 12.0 deaths/1,000/year
- Overall post-invasion: 7.2 deaths/1,000/year

## Non-violent death rates

The deaths recorded for the pre-invasion period in both the 2004 and the 2006 surveys were almost entirely non-violent deaths. (We define non-violent deaths as not due to intentional violence—that is, our non-violent deaths include deaths in “accidents,” such as traffic fatalities.) Immediately post-invasion, the death rate due to non-violent causes dropped slightly, then stayed level for the next period, but began to rise in the period from June 2005 until June 2006. The excess death rate due to non-violent causes is estimated to be 1.2 deaths/1,000/year for this most recent period of time, and 2.0 deaths/1,000/year for the first six months of 2006. It is not possible to say that this number is a statistically significant increase over the pre-invasion baseline death rate. However, this may represent the beginning of a trend toward increasing deaths from deterioration in the health services and stagnation in efforts to improve environmental health in Iraq.

## Estimating deaths among the Iraqi population

Using the figure of 5.5 deaths/1,000/year as a baseline for the following years, then any rate above this figure would be considered excess deaths. For the entire post-invasion period the excess deaths were 7.2/1,000/year. When these rates of excess deaths are applied to the population of the survey area (26.1 million), we estimate that through July 2006, there have been 654,965 excess deaths in Iraq as a consequence of the war from all causes.

Excess deaths can be further divided into those from violent and from non-violent causes. The vast majority of excess deaths were from violent causes. The excess deaths from violent causes were 7.2/1,000. Applying this to the population we estimate that 601,027 were due to violent causes.

This would leave 53,938 excess deaths due to non-violent causes. The number of deaths from non-violent causes remained more or less the same through the early 2006 when they began to rise.



The geographic distribution of deaths by governate is represented Figure 2, showing the highest death rates much where they would be expected, in the Sunni Arab provinces.

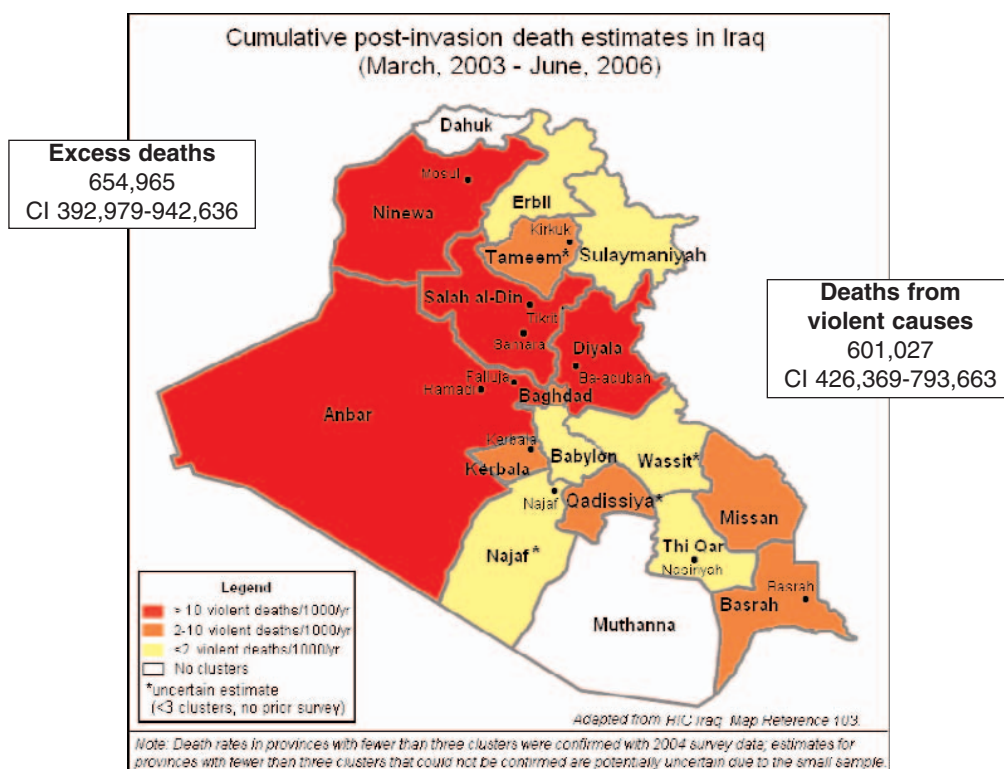


Figure 2. Death rates due to violent causes, by governate.

## Weapons causing death

From the accounts of households, it was almost always possible to identify the weapon or type of ordinance responsible for the death of the household member. This is seen in Table 2 on the following page.

From the beginning, the major cause of deaths was due to gunshots. Air strikes were common causes of death in the beginning. Air strikes caused about 13% of deaths from known causes throughout the war. In some places air strikes caused a large proportion of deaths. Increasing deaths from car bombs developed later. In some cases, what was classified as a car bomb might have been a mortar shell impacting on an automobile.

**Table 2: Source of violence**

	<i>Pre-invasion</i>	<i>Mar 03-Apr 04</i>	<i>May 04-May 05</i>	<i>Jun 05-Jun 06</i>	<i>Total</i>
Violent, coalition	1 (50%)	16 (36%)	35 (39%)	43 (26%)	95 (31%)
Violent, other	0	4 (9%)	17 (19%)	50 (30%)	71 (24%)
Violent, unknown	1 (50%)	25 (56%)	38 (42%)	72 (44%)	136 (45%)
Gunshot	0	36 (80%)	46 (51%)	87 (53%)	169 (56%)
Car bomb	0	1 (2%)	7 (8%)	30 (18%)	38 (13%)
Other explosion/ ordnance	1 (50%)	1 (2%)	21 (23%)	20 (12%)	43 (14%)
Air strike	1 (50%)	6 (13%)	13 (14%)	20 (12%)	40 (13%)
Violent, unknown	0	0	2 (2%)	4 (2%)	6 (2%)
Accident	0	1 (2%)	1 (1%)	4 (2%)	6 (2%)
Total deaths	2	45	90	165	302



## Responsibility for deaths

Households were asked what party was responsible for the killing of their household member. In many cases it was not clear. There was great difficulty in identifying which were criminal events. Only when the household was certain that the death was as a consequence of coalition actions was this recorded as such.

In Figure 3 below we have shown the entire pattern of deaths for the survey years. The deaths from coalition forces prior to the invasion were related to air strikes in the time leading up to the invasion. For this survey, the deaths recorded were those that households attributed to specific parties. We had no independent method for identifying parties responsible for these deaths.

The percentage of the deaths that were attributed to coalition forces varied from year to year. However the absolute numbers of deaths attributed by households to coalition forces rose through 2005, then levelled off during 2005, only to start rising again in 2006. For 2006, a smaller proportion of death was attributed to the coalition, but the number of people killed in 2006 from all causes substantially increased, and this increase means a larger actual number of deaths occurring from attacks attributed to the coalition. As can be seen from Figure 3, however, the growing proportion of deaths not specifically attributed to coalition forces rose significantly in the last year.

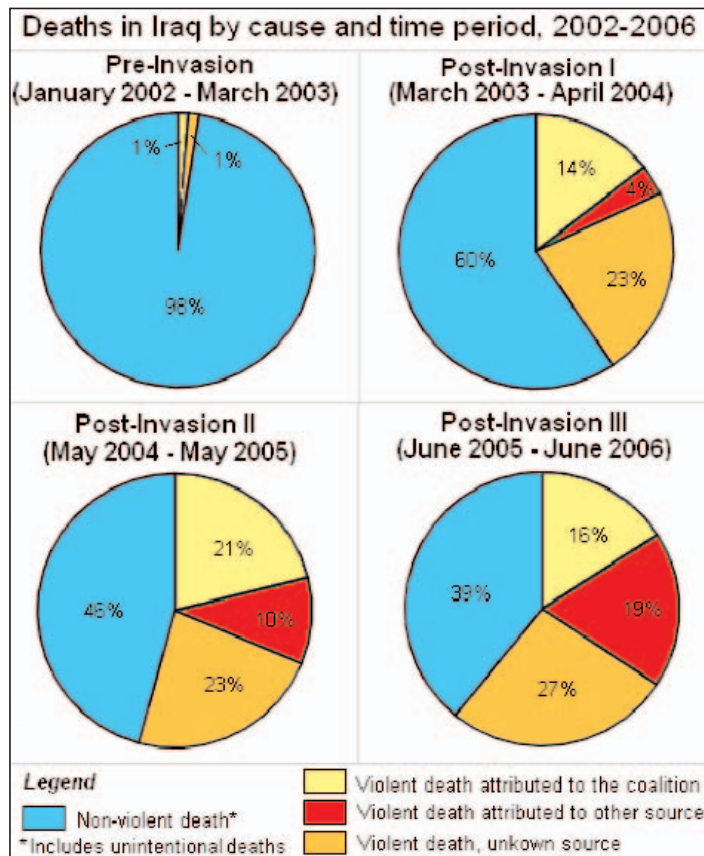


Figure 3.

## Age distribution of deaths

Figure 4 shows the age and sex for all deaths in the survey households and those deaths that were reported from violent causes. The first graph shows all deaths. The pattern for females is what would be usual for both males and females, in almost all countries of the world. However, in this graph there is a great excess in deaths among males of all ages in comparison with females. In the next graph is shown the deaths from violent causes by age and sex. As can be seen, violent deaths account for most of the deaths, and violent deaths are almost entirely in males. Among the males, there were no practical survey methods to determine which of the deaths were among active combatants. It is interesting to note that the largest single age group of female deaths was among the under age 15 years.

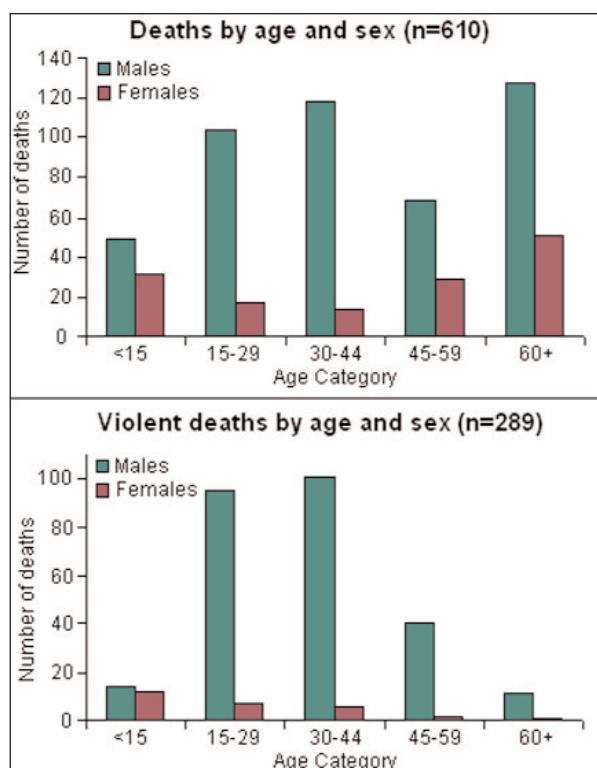


Figure 4.

## The 2004 survey compared with the 2006 survey

Since the 2006 survey included the period of time contained in the 2004 survey, we could compare these two results for the time frame from January 2002 through August 2004. In 2004 we estimated that somewhere in excess of 100,000 deaths had occurred from the time of the invasion until August 2004. Using data from the 2006 survey to look at the time included in the 2004 survey, we estimate that the number of excess deaths during that time were about 112,000.

That these two surveys were carried out in different locations and two years apart from each other yet yielded results that were very similar to each other, is strong validation of both surveys.

## Limitations

Any collection of information is open to potential bias, and has limitations. All efforts were made to randomly select the households to be included in this survey, but it may have been that households with more deaths or households with fewer deaths were over represented in this survey. The finding that the 2006 results are very close to the 2004 household results suggests this did not occur. As in all surveys, a larger sample would have likely have produced a result with greater precision, although this would have exposed the survey teams to higher risk. In the future, when safety has improved, a large survey will be needed to determine in detail the total implications of the conflict for the people of Iraq.

The households were selected for this survey according to population size we obtained from the Ministry of Planning, but this may not have fully reflected migration within or outside the country. However, it is unlikely that this would have occurred at a scale necessary to affect findings.

Perhaps the greatest potential limitation to this type of survey is the problem people have recalling the date of specific events, especially over several years. Again, the close similarities between the 2004 and the 2006 data suggest this was not a major problem. Households could have concealed deaths from the interviewers, though by promising anonymity to households we tried to minimize this risk. We are certain that households did not report deaths which did not occur, as 92% of households had death certificates for deaths they reported.

In the news media coverage of the 2004 survey report, much was made of the wide confidence intervals, which is a statistical technique that was frequently misunderstood. With the much larger sample of the 2006 survey, the confidence intervals are narrowed significantly. For the single most important category—the total number of deaths by violence during the war—the confidence interval ranges from 426,369 to 793,663. That means that we are 95% certain that the correct number is between those two, and 601,027, is the statistically most probable number. The likelihood that another number is the correct number decreases very rapidly as one moves up or down from the figure of 601,027.

## Conclusion

The number of persons dying in Iraq has continued to escalate with each year. The proportion of deaths ascribed to coalition forces has diminished in 2006. However, the actual numbers of Iraqis whose deaths are ascribed by household members to the coalition have increased each year. Gunfire remains the most common reason for death, though deaths from car bombings have increased from 2005. Deaths from non-violent causes have increased for 2005 and 2006 suggesting a trend in deaths due to deterioration in health services and the environment health threats, as well as decreasing access to health services. From a statistical standpoint, the numbers of deaths due to non-violent causes is too small to reach definitive conclusions.

Our best estimate is the 654,965 persons have died as a consequence of the conflict. Of these, 601,027 have died from violence. While the actual value may be somewhat higher or lower than this number, the precision of these results is adequate to conclude that loss of life in this conflict has been substantial. This is far greater than reported by various media accounts and morgue tallies. This is not surprising, as reporting of events from incomplete sources cannot, in any statistically meaningful way, be converted into national death rates. Other than Bosnia, we are unable to find any major historical instances where passive surveillance methods (such as morgue and media reports) identify more than 20% of the deaths which were found through population-based survey methods.<sup>10, 11, 12, 13</sup>

As with other recent conflicts, the civilians of Iraq bear the consequence of warfare. In the Vietnam War, 3 million civilian died; in the Congo, armed conflict has been responsible for 3.8 million deaths; in East Timor, an estimated 200,000 out of a population of 800,000 died in conflict.<sup>14, 15, 16</sup> Recent estimates are that 200,000 have died in Darfur over the past 31 months.<sup>17</sup> Our data, which estimate that 654,965 or 2.5% of the Iraqi population has died in this, the largest major international conflict of the 21st century, should be of grave concern to everyone.

## Recommendations

Standard methods for estimated to burden of disease from conflicts in a reliable manner exist. In this and other conflicts it has been shown that estimation of death rates can be done in a meaningful manner. We recommend that an international mechanism be established to regularly monitor deaths due to conflict and their causes to provide information that will help protect the lives of persons caught up in the midst of conflict.

## Acknowledgments

We gratefully acknowledge the assistance of Scott Zeger in the study design and analysis, Elizabeth Johnson with statistical analysis, and Court Robinson and Stan Becker, who helped with the study conceptualization and demographic analysis. John Tirman of MIT edited this report.

We express our deepest admiration for the dedicated Iraqi data collectors who have asked not to be identified.

- <sup>1</sup> Department of Defense. Measuring Stability and Security in Iraq. Washington: DoD, August, 2006.
- <sup>2</sup> Iraq Body Count. <http://www.iraqbodycount.net/> (accessed Sept 15, 2006).
- <sup>3</sup> SMART Program. [http://www.smartindicators.org/SMART\\_Brief-June\\_28\\_2004.pdf#search=%22smart%20indicators%20mortality%22](http://www.smartindicators.org/SMART_Brief-June_28_2004.pdf#search=%22smart%20indicators%20mortality%22) (accessed September 10, 2006).
- <sup>4</sup> Roberts L, Lafta R, Garfield R, Khudhairi J, Burnham G. Mortality before and after the 2003 invasion of Iraq: a cluster sample survey. *Lancet*, 2004, 364: 1857-64.
- <sup>5</sup> O'Hanlon, ME, Kamons, A. Iraq index: tracking variables of reconstruction and security in post-Saddam Iraq. The Brookings Institution, August 2006.
- <sup>6</sup> CIA 2003 Factbook entry for Iraq. <http://permanent.access.gpo.gov/lps35389/2003/iz.html> (accessed 1 Sept 2006).
- <sup>7</sup> US Agency for International Health and US Census Bureau. Global Population Profile: 2002. Washington: US Census Bureau, 2004.
- <sup>8</sup> United Nations Development Program, Iraq Ministry of Planning and Development Cooperation. Iraq 2004 Living Conditions Survey, Vol 1: Tabulation Report. New York: UNDP, 2005.
- <sup>9</sup> There was miscommunication and some clusters were done in the wrong locations. These were dropped in the analysis to ensure the samples used for analysis was truly representative of the population.
- <sup>10</sup> Spiegel PB, Salama P. War and mortality in Kosovo, 1998-99: an epidemiological testimony. *Lancet*, 2000; 355:2204-9.
- <sup>11</sup> Malfait P, Moren A, Dillon JC, et al. An outbreak of pellagra related to changes in dietary niacin among Mozambican refugees in Malawi. *Int J Epidemiol*, 1993; 22:504-11.
- <sup>12</sup> Roberts L, Despines M. Mortality in Katana Health Zone, Eastern DRC. *Lancet*, 1999; 353:2249-50.
- <sup>13</sup> Goma Epidemiology Group. Public Health Impact of Rwandan Refugee Crisis: What Happened in Goma, Zaire, in July, 1994. *Lancet*, 1995; 345:339-44.
- <sup>14</sup> Allukian M, Atwood PL. Public health and the Vietnam War. In *War and Public Health*, Levy BS, Sidel VW, eds., Washington, DC; American Public Health Association, 2000.
- <sup>15</sup> Coghlan B, et al. Mortality in the Democratic Republic of Congo: a nationwide survey. *Lancet*, 2006; 367:44-51.
- <sup>16</sup> CNN. US approved E. Timor invasion: documents. <http://archives.cnn.com/2001/WORLD/asiapcf/south-east/12/06/indonesia.timor.us/> (accessed Sept 10, 2006).
- <sup>17</sup> Hagan J, Palloni A. Death in Darfur. *Science*, 2006; 313:1578-9.

## Measuring Deaths in a Population: The Cluster Survey Method

Measuring population characteristics is almost always based on sampling. This could be about deaths, births, or disease present, but it just as well could be voting intentions, number of pets in the household or most-watched television programs.

The basis of sampling is that a characteristic of the whole can be determined from parts selected at random from that whole. Various mathematical formulae allow calculation of how many parts are required to be assured that the result is indeed representative of the whole. It is usual for a survey to be designed with a 95% confidence that the result is within 80% (or some number that we chose for other reasons) of the true value for the whole (precision). Using such formulae, we can determine how many persons we would have to survey to satisfy the criteria set for the confidence and precision of the results. This is called the *sample size*. The more confidence we desire for our results, and the more precision we want, the larger the sample must be. Sometimes this involves just more people and more training, but as in the case of the Iraq study, it involves increasing the exposure to danger. Survey takers have been killed in Iraq, but fortunately none from our teams.

Once we decide on the sample size, we need to determine how to find those numbers of the parts that make up the whole. For people, we speak of the whole as the *population*. These parts should be found by *random* (not haphazard) methods. The simplest way is to make a list of everyone in the population (the whole), and randomly choose the number needed from this list. This is known as simple random sampling.

Cluster sampling, which involves the random selection of clusters of people (or households) instead of individual people, is a valid alternative to simple random sampling. In conflicts and in many developing countries, the listing of all persons or households in an area to be sampled is seldom available. An alternative is the cluster survey, which selects a certain number of clusters (usually not less than 30) from the area to be surveyed. In the area of interest, each of the towns or administrative units is listed by the best estimate of population sizes, and a running total of these populations is made.

The total population is then divided by the number of clusters to give the *sampling interval*. If we were to visit 30 clusters in a county with a population of 120,000, our sampling interval would be  $120,000 \div 30 = 4,000$ . This means every 4,000<sup>th</sup> person in the county would live in one of the clusters we will want to visit. We then list all the towns in the county by their population (in any order). Our first cluster is the town where person 4,000 lives, our second cluster is in the town where person 8,000 lives, the third cluster is where person 12,000 lives, and so on until we have our 30 clusters. We really don't need to know who person 4,000 is, just the town where he or she lives. If we listed the towns alphabetically, then we would know automatically which town would be the first cluster chosen, and it would not be random. However, if we pick our first cluster with a random number, then it could be several places. If the random number is too big (bigger than 4,000), then we will not get 30 clusters for the country. So the rule is that the random number is chosen for the first cluster, which is less than the sampling interval—in this example, 4,000.

As the towns or administrative units are listed by populations, bigger towns are likely to be selected for

more clusters. This is a basic sampling principle: the chance of being selected is equal for everyone, whether you live in a big city or a small town. In this way, all people and all households have an equal chance of being included in a survey.

Once the cluster is selected, additional sampling stages are required to locate neighborhoods and eventually a single house where to start. For each of these selection stages, a random process is used so there will be no bias to select one location over another. Once the “start house” or location is selected, then the survey team moves to the next nearest (or sometimes the second or third nearest) house until the specified number of houses are selected (often from 10-50) to be interviewed in that cluster. The same is done for the other clusters.

A problem with cluster surveys is that households adjacent to each other are more likely to be similar than those located farther away. In the case of localized violent events, the same event is likely to affect households close together. This makes simple random sampling a stronger survey method where this is possible. But in war this is seldom possible.

To compensate for this “clustering effect” (sometimes called the *design effect*), the number of households or persons in a cluster sample is increased over that of a simple random sample in order to provide adequate precision. As one does not know the extent of “clustering” before the survey is started, it is usually estimated at two, meaning that a cluster survey would need twice the number of households as a simple random survey in order to have equal statistical power.

Afterwards, the clustering or design effect can be calculated from the results to see if the estimate of 2.0 was indeed correct. In the 2006 Iraq mortality study, during its analysis this effect was found to be only 1.6—that is, the number of households in the cluster sample needed to be 1.6 times the size of a completely random household sample in order to have the same statistical power, or in terms of confidence intervals, to give an equally precise result. This standard was achieved, because an effect of 2.0 had been allowed for in the design. In other words, the final number of households surveyed—1,849—was greater than what was needed for such precision.

Cluster sampling is the method that gives us much of our information about health of populations in developing countries. It has been accepted as an effective tool for measuring deaths in previous conflict situations such as in the Democratic Republic of Congo,<sup>1</sup> during post Gulf War sanctions,<sup>2</sup> in Kosovo,<sup>3</sup> in Darfur,<sup>4</sup> and in Angola.<sup>5</sup> The results of these studies were widely used to establish policy by governments and the United Nations. The US Government, the Canadian Government, UN agencies (especially UNICEF) and many other organizations have supported development of these methods both in peacetime and during conflict.

Validation of cluster sampling methodologies as an appropriate alternative to simple random sampling is difficult in conflict situations. However, there have been multiple initiatives to validate this method in measuring public health outcomes such as mortality, demographics, and nutritional and disease status in stable circumstances. The Standardized Monitoring and Assessment of Relief and Transitions Initiative (SMART), a collaborative network through USAID seeking to standardize and evaluate methodologies among humanitarian organizations, has established cluster sampling as an acceptable method of sampling in conflict.<sup>6</sup> In stable situations, the USAID-supported Demographic and Health Surveys (DHS), which frequently use cluster sampling in stable countries to measure death rates, have obtained results that are almost identical to data measured through a national census.<sup>7</sup> The data derived from cluster sampling from DHS have been used to inform many health policy decisions by donor countries, and is one of the United States’ major contributions to public health knowledge.



## Collecting the Data

The mortality survey was a partnership between American and Iraqi academics with the field data collected by teams of male and female Iraqi physicians. To protect their safety, they are not identified in this report. Pollsters and others trying to collect information in Iraq have been threatened, mistreated, and even killed. After the 2004 Iraq survey of deaths, considerable time was spent designing the follow-on study that would have the maximum precision while minimizing risk to survey teams. This survey—the subject of this report—was completed without deaths or injuries to the survey teams.

The tasks of going out every day to many different locations in the country faced numerous perils. Due to administrative delays at the sponsors' universities, the survey did not begin until late spring, and the often-oppressive heat sometimes reached 55° Celsius (130° F.) in the shade.

Getting to the survey sites was difficult. U.S. checkpoints were particularly challenging, due to the rules of engagement, suspicion, and the doctors' mission. Iraqi checkpoints were less problematic, but militias and political parties, as well as criminals, all posed significant dangers. The militias, says the survey team leader, "are unpredictable, they are very smooth when they know that we are from 'their side.' Generally, they didn't threaten our lives. They stopped us three times [in different regions]. In the first, they kept us for a few hours for checking, in the second they took us to their commander, and the third time they did not allow us to go, so we turned back." The criminal gangs, he says, are "miscellaneous groups with different visions and goals. They may kill for any reason: money, revenge, and even for fun."

Once in the clusters, the teams faced suspicion initially, especially at the first house selected in the random process. Lengthy explanations of the purposes of the survey—and that it would help the Iraqi people—were necessary to allay fears. In some areas, people were more welcoming, and all but a very few of the entire sample were eventually very cooperative.

Returning from the clusters was every bit as perilous as going to them, and the teams were exposed to this danger constantly.

American and Iraqi team members met twice across the border in Jordan, first to plan the survey and later to analyze the findings. The Johns Hopkins members of the research team are in awe of the courage and persistence of our Iraqi colleagues.



## Other Accounts of Mortality in Iraq

There are several other efforts to account for the dead as a result of the Iraq war.

**Iraq Body Count** (IBC) has been the most widely cited source for ongoing civilian casualties in Iraq since the 2003 invasion ([www.ibc.org](http://www.ibc.org)). This independent UK-based project accounts for deaths through comprehensive and thorough surveys of news media sources around the world. After independent review by at least two members of the project team, the maximum and minimum values are compiled onto a website that is updated daily. These figures are derived from a comprehensive survey of online media reports and eyewitness accounts.

The founders of IBC believe that each civilian death is a tragedy, and that it is a moral and humanitarian duty for each death to be recorded and compiled. The website cites a quote by General Tommy Franks stating that, “We don’t do body counts” and thus, a primary motivation of this project is to take on the duty they believe is the responsibility of American and British citizens.

The IBC uses passive surveillance techniques, which depend upon available reports from the news media, in contrast to an active search for dead bodies. This brings about the possibility of gross underestimations. A significant number of deaths are not reported by the media, especially ones that occur in less populated or well known areas. In addition, the IBC methodology is conservative and excludes data that do not meet their set standards. Marc Herold, an economist on the IBC team, believed that the count is likely too low because thousands of deaths may go unreported due to lack of media coverage.<sup>8</sup>

In the absence of active surveillance measures, passive surveillance is a useful and necessary tool to gather information, but it is important that the information is taken in the correct context. Unfortunately the careful and conservative numbers recorded by IBC are often taken out of context and cited as the true body count, thus lulling people into thinking that the human consequence of the war is far less than it really is. IBC has played a highly commendable role in making people aware of the upward spiral of deaths in Iraq.

Working for the **U.N. Development Program**, the highly regarded Norwegian researcher Jon Pederson led a survey that recorded between 18,000 and 29,000 violent deaths during the first year of occupation. The survey<sup>9</sup> was not focused on deaths, but asked about them over the course of lengthy interviews that focused on access to services. While this was more than twice the rate recorded by IBC at the time, Pederson expressed concern for the completeness and quality of the data in a newspaper interview last year.<sup>10</sup> The surveys reported in *The Lancet* were focused solely on recording deaths and count about two and a half times as many excess deaths from all causes over the same period.

The **U.S. Department of Defense**, using passive surveillance techniques, has begun to account for casualties in a broadly defined way, including numbers of attacks, without estimating totals but showing trends lines that are almost identical to IBC and *The Lancet* accounts.<sup>11</sup>

There is also a widely circulated UPI report of a count by **‘Iraqiyun**, a humanitarian organization, totaling 128,000 dead over the first 27 months of the war.<sup>12</sup> The methods of this organization—reported to be direct accounts from relatives of those killed—could not be confirmed.

The **Ministry of Health** in Iraq has published some numbers from time to time, but these are generally considered to be unreliable. The registration of deaths in Iraq has been an organized process for many years. Death certificates have traditionally been obtained for the deaths of all adults and older children. Death certificates are required for insurance claims, compensation, payment of benefits, and for burial. Cemeteries do not take bodies for burial without certificates. If deaths occurred outside of hospital, the bodies would be transported to the general hospital for the certificate to be issued. If there were doubts

about the cause of death, a post-mortem examination would be carried out before issuing a certificate. Copies of the death certificates would go to the national offices managing vital registration.

This process has continued through the current conflict, with death certificates being required for burial, and with information from certificates being duly recorded. However, the tabulation of data from registration of deaths in Iraq has suffered from the chaos of the current conflict. Beyond this, there is also a suspicion that records of death, particularly related to violent deaths, is being manipulated and only partially being released for various political reasons.

Even with the death certificate system, only about one-third of deaths were captured by the government's surveillance system in the years before the current war, according to informed sources in Iraq. At a death rate of 5/1,000/year, in a population of 24 million, the government should have reported 120,000 deaths annually. In 2002, the government documented less than 40,000 from all sources. The ministry's numbers are not likely to be more complete or accurate today.

The figure below shows trend lines from three different accounts—our mortality survey, Iraq Body count, and the Department of Defense report. Although the numbers we estimate through population-based methods are substantially greater than the numbers of deaths counted by the other two, the figure shows that over time the trends are almost identical. This is clear evidence that the three studies have measured the same events, and further reinforces the results of the population based data. This difference in numbers but similarity in trends is typical of the differences between active and passive public health surveillance seen in many conditions.

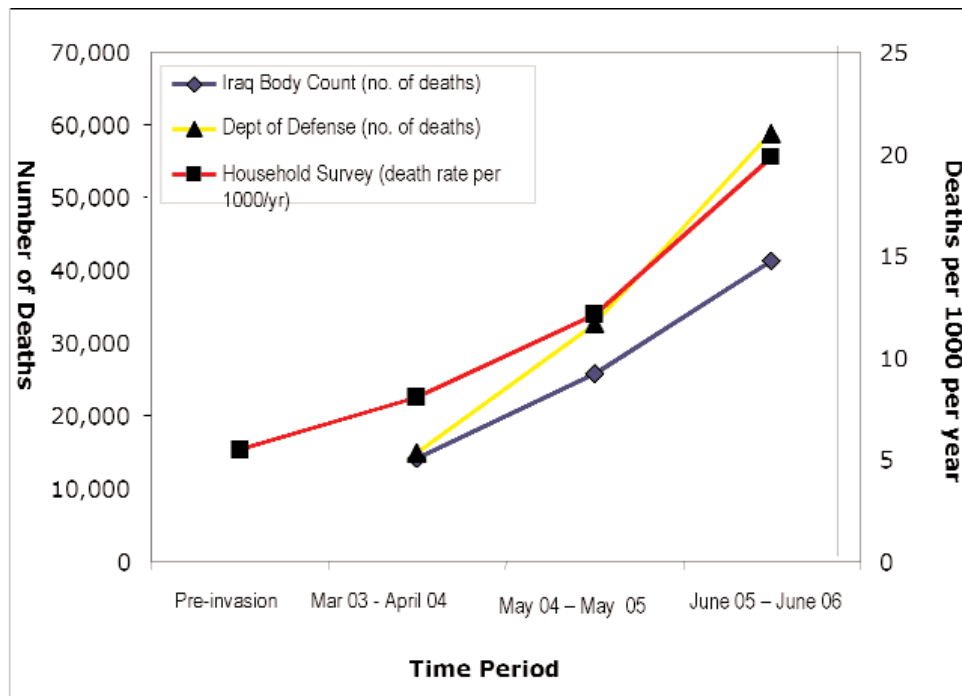


Figure 5. Trend lines of different mortality accounts. The reference axis for Iraq Body Count and the Department of Defense reports are on the left. For this study, the reference axis is on the right.

## U.S. Military Casualties and Deaths and Their Long-Term Consequences

Since the beginning of the U.S. invasion of Iraq three and a half years ago, some 2,700 American soldiers have been killed, and 20,000 injured. For every death there are just under 8 injuries reflecting military medicine's ability to save lives despite massive injuries. One study reported noted a 97% survival rate in combat casualties at a Naval Hospital Surgical ward in California.<sup>13</sup> The injury rate for soldiers in Iraq is 34 per 1000, with only 3.3 deaths/1,000, the lowest in American military history.<sup>14</sup> By contrast, 1 in 3 US personnel with injuries died during World War II, and 1 in 4 in Vietnam.<sup>15</sup>

Because of the high survival from battle injuries, new physical and mental health challenges have arisen. Soldiers who would have never survived their injuries in the past are now living, in some cases, as triple amputees with brain damage.<sup>16</sup> Many injuries include second and third degree burns, broken bones and amputations, shrapnel wounds, brain injuries, paralysis, and blindness.<sup>17</sup> Extremities are especially vulnerable to home-made Iraqi ammunition and are unprotected by Kevlar vests. Two out of three wounds incurred by soldiers involve the extremities, and 436 soldiers more than 2% wounded in action are amputees.<sup>18</sup>

Less visible but just as debilitating is the mental and psychological trauma that many veterans face. A recent study in JAMA reported that 19.1% of returning Iraq war veterans suffer from psychiatric conditions, which most often include depression, anxiety, substance abuse, and Post Traumatic Stress Disorder (PTSD).<sup>19</sup> Other mental health concerns such as difficulty readjusting to civilian life and impairment in social functioning are also prevalent.

Among those surveyed in a 2004 report in the *New England Journal of Medicine* article, it was reported that the rate of mental disturbance, especially PTSD, was directly proportional to the number of direct firefights encountered while deployed.<sup>20</sup> Strong predictors for psychiatric problems include being shot at or wounded, handling dead bodies, knowing someone who was killed, or killing enemy combatants. Killing of innocent bystanders, or having to witness such killings without the ability to intercede, is also associated with more intense psychiatric manifestations.<sup>21</sup> This is of significant concern due to the large numbers of civilians killed during this current conflict by both coalition forces and the insurgency. The risks of modern military combat will have long-term consequences for the survivors, families, the health care system and society.

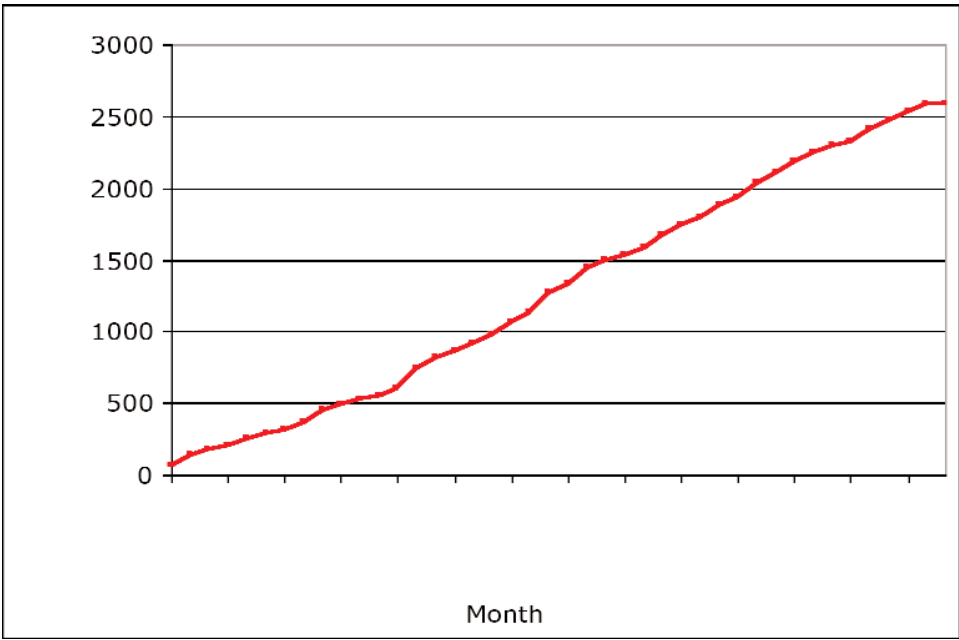


Figure 6. Cumulative U.S. Military Deaths since March 2003

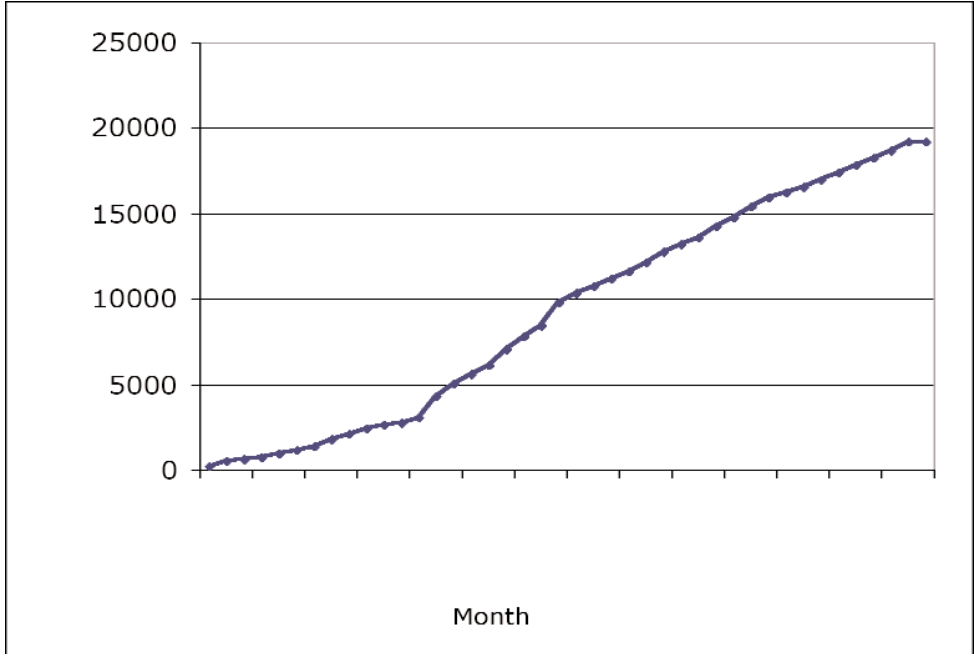


Figure 7. Cumulative U.S. Military Non-fatal Casualties since March 2003

## Health in Iraq

The series of events beginning with the Iran-Iraq war through the Persian Gulf War and the period of trade sanctions all had major effects on the health of Iraqis. During this period, several health assessments were carried out, all pointing to deteriorating health status among Iraqis. Many of these surveys concentrated on measurement of child health. As children are the most vulnerable members of a community, child health is a sensitive indicator of a community's overall health status. Surveys conducted between January and August 1991, estimated that more than 46,900 children died as a consequence of war and sanctions, a three-fold increase from the period prior to the war.<sup>22</sup> Estimates in 1995 suggested that the effects of sanctions had increased the death toll among children.<sup>23</sup> Evident in the graph below, the UN Oil-for-Food program introduced in 1996 helped improve conditions considerably, but this program had many difficulties.<sup>24</sup>

On the eve of the 2003 Iraq war, the country's social fabric and its infrastructure had not recovered from the 1991 Gulf War, and the country was ill prepared to face new hardships. Food insecurity was still widespread. More than 40% of the population was dependent on government rations and public food supplies, and 15.4% of the population lacked adequate food.<sup>25</sup> In a 2003 survey by the World Food program, 17% of children were found to be underweight and 32% chronically malnourished or stunted.<sup>26</sup> Although children between one and five are particularly prone to these challenges, death due to malnutrition alone is rare. Malnutrition contributes to death from other conditions such as diarrhea, pneumonia and infections such as malaria or typhoid. Nutrition-related mortality is typically concentrated in children in their first year, which includes less than 5% of the Iraqi population. Because of this demographic pattern, food insecurity has relatively little effect on overall crude mortality compared with violent deaths, which affect all age groups.

Environmental hazards from chemical, biologic, and radioactive pollution during prior conflicts also pose a health risk. Oil spills and oil well fires during the Gulf war caused air pollution, soil contamination, heavy bombing, and vehicular movement caused further degradation of the environment. Water and sewerage capacity was never fully restored after the Gulf war bombing.

Of particular concern is the cluster of cancers and genetic defects now being reported from Basra. There has been some suggestion that this is associated with depleted uranium (DU) usage in anti-tank weapons by the US Army during the 1991 war. It has subsequently contaminated the ground water in Basra, on which 40% of Basra's population depends on for drinking water.<sup>27</sup>

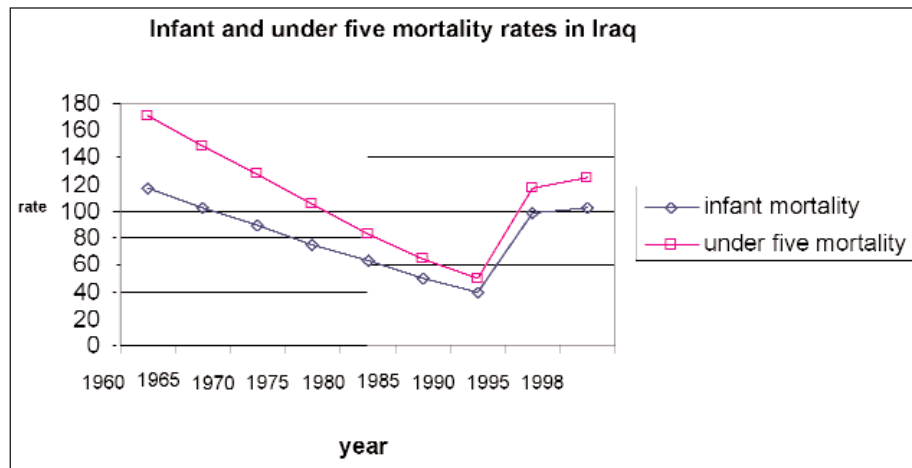


Figure 8. Infant (under 1 year) and child mortality (under 5 years) rates (per 1,000/year) for Iraq. These declined steadily from the 1960s to reach quite low levels (USA=11) in 1990. The subsequent wars and sanctions have wiped out 20 years of progress in child health.<sup>28</sup>

The Iraqi health care system was once the finest in the region, but has been in decline for several decades. At this time, it is no longer able to fully meet the health needs of its population. Fragmented services, poor standards of care, and inefficient referral systems are all in part due to pre-existing corruption, neglect, and shortages that arose during Saddam Hussein's rule and from sanctions. The medical system was also crippled by intellectual embargos that prevented import of medical textbooks or journals into the country during the 1990s. Lack of regulation and management placed a strain on the already dwindling health care resources.

Compounding this issue are frequent health leadership changes in a system that finds it hard to conduct the long-term planning needed to restore health services. Weak supporting structures such as health information systems, finance management and human resource management in health, coupled with a weak government makes it hard for over-extended leadership to act decisively.

The 2003 Iraq War resulted in further destruction of vital infrastructures for food, water, security, and sanitation. As the health system further deteriorates, doctors and other health care workers are leaving Iraq. It was recently estimated that of the 34,000 doctors present in 2003, 12,000 have now emigrated and 2,000 have been murdered.<sup>29, 30</sup> Much of the health care now being provided in Iraq comes from the unregulated private sector. The coalition's efforts to rebuild health facilities have largely faltered.

## How Are So Many Fatalities Possible?

Precisely how so many people have been killed in Iraq is a natural question. While the survey is not designed to answer such a question, apart from general attributions, a few observations may be helpful in grasping the scale of mortality during the war.<sup>31</sup>

- Much violence is occurring far from the view of journalists and widely cited mechanisms for counting the dead. Most Western reporters are based in Baghdad. Even there, large-scale events tend to gain attention, not the numerous but scattered incidences of violence that also occur.
- Baghdad has one-fifth of the nation's population, or about 5 million. Another 5 million live in the three Kurdish provinces in the north, which are relatively peaceful. Some 15 million live in the remainder of Iraq, and with the exception of Mosul, Kirkuk, and Basra, where there is some foreign press presence, Iraq is largely hidden from the view of Western journalism.<sup>32</sup> This mortality survey also suggests much more violence is occurring outside Baghdad.
- Those who read the Arabic press say that many incidences of violence are reported in such news media that are never reported in the English-language press.
- The large rise in sectarian violence, and the survey's findings regarding gunshots being the principal cause of death, correlate closely. They also reflect the reports of widespread assassinations. If, for example, there were three such killings daily in each of the 75 or so urban centers of Iraq<sup>33</sup> (outside of Baghdad and the Kurdish north), the total for the 40 months covered by this survey would equal more than 270,000; four such killings daily in those 75 cities would equal 360,000 in that period.
- The deaths attributed to actions by the coalition are a fraction of overall deaths, but are still significant. The U.S. air force and navy fly thousands of sorties annually as "close air support" of ground operations; how much ordnance is dropped is not reported. Thousands more helicopter gunship operations are flown. Between 200 million to one billion small-caliber rounds of ammunition or more have been expended in Iraq by the U.S. forces, and requirements for small and medium caliber ammunitions have risen steadily.<sup>34</sup> It cannot be said what the significance of these numbers are for mortality, but they do indicate a very large scale of operations. Reports of rules of engagement that are assertive also lend credence to the probability of many tens of thousands of deaths (including insurgents).<sup>35</sup>
- We know much more about U.S. and British operations than those of the irregular forces of Iraqis—especially the Sunni Arab insurgents and the Sunni and Shia militias. Here the difficulty of correlating deaths to operations is large. We do know that the numbers of weapons available to militias, criminals, and insurgents are high. According to one report, more than 4 million small arms and light weapons "went missing" after the March 2003 invasion.<sup>36</sup>
- While not direct evidence of a scale of violence, the very large Iraqi majorities that blame the U.S. for the violence and support insurgent attacks on U.S. troops are both striking and indicative. The polls were conducted in Iraq on behalf of the State Department and Program on International Policy Attitudes at the University of Maryland.<sup>37</sup> Because the polls were large samples (1,870 and 1,150 respectively) and nationwide, they indicate just how widespread significant violence is in the country.

The war has presented many different challenges to those trying to understand its depth and range. It is unconventional in many respects—not least due to the dispersed and decentralized nature of the insurgents and militias, and the sectarian and ethnic animosities at work in addition to resistance to the occupation. Many aspects of the war are not reported or are reported inadequately. As a result, the overall picture we have of the course of the war has large gaps, and among those is the full extent and nature of violence. Nonetheless, there are plausible explanations for the large scale of violent deaths reported in the mortality survey.



## Policy Implications of High Mortality

The large scale of mortality during the Iraq war has implications for how the war is being conducted by the United States. While not within the scope of the survey itself, it is worth raising a few points and questions relevant to political and military policies, strategy, and tactics.

- The overall scale of death from the beginning of the war, and the constant rise in mortality, clearly demonstrates that the United States and other legitimate armed forces are not adequately providing security, and indeed that everyday insecurity is increasing for most Iraqis.
- Large numbers of noncombatants are dying as a direct consequence of the violence.
- The health care system is showing signs of weakening.
- The sharp rise in the respondents' attribution of violent deaths to forces other than those of the U.S.-led coalition clearly tracks with reports of growing sectarian and ethnic violence, as does the steady rise in deaths by gunshots.
- The violence and insecurity throughout the period of the survey could be creating a feedback loop in which greater insecurity leads to greater violence. Insurgents may believe they are acting to protect their families and communities, for example. The American application of force may be a stimulant to more insurgency; recent doctrinal changes in the army reportedly recognize this.
- The overall scale of violence and the large representation of young men in the mortality figures may indicate a much larger insurgency and/or membership in militias than is widely estimated.
- The political arrangements, such as the constitution of Iraq, which may lead to divisions along ethnic and sectarian lines reinforce the distrust and fear that can spur more violence.
- The growth in violence and the primary use of guns in that deadly violence indicate a continuing rise in the numbers participating in violent activities.
- Quite a significant portion of violence is occurring outside Baghdad, even though the capital is the focal point of attention for U.S. security strategy.
- An apparently high prevalence of assassinations, and their growth, underscores how little is known about the militias and insurgencies, and what strategies or tactics could be put into place to reduce this violence.
- The high mortality for young men raises questions about social viability and future reconstruction efforts for Sunni Arab regions in particular.
- Recent opinion polls in Iraq, published by the Washington Post (Sept. 26-27), indicate very large majorities of Iraqis believe that the application of U.S. military force is responsible for the widespread violence in their country, and believe that withdrawing U.S. troops will reduce violence.
- It cannot be predicted, based on the mortality figures and trends, how a rapid withdrawal of U.S. forces would affect security for Iraqis.

# References in Appendices

- <sup>1</sup> Les Roberts et al., Mortality in eastern Democratic Republic of Congo. International Rescue Committee, New York: 2001.
- <sup>2</sup> Ascherio A, Chase R, Cote T, *et al.* Effect of the Gulf War on infant and child mortality in Iraq. *NEJM*. 1992; 327: 931-6.
- <sup>3</sup> Spiegel PB, Salama P. War and mortality in Kosovo, 1998-99: an epidemiological testimony. *Lancet* 2000; 355: 2204-09.
- <sup>4</sup> Depoortere E, et al. Violence and mortality in West Darfur, Sudan (2003-04). *Lancet*. 2004 Oct 9-15; 364(9442):1315-20.
- <sup>5</sup> Sapir DG, Gomez VT. Angola: The Human Impact of War. Brussels: Université catholique de Louvain, 2006.
- <sup>6</sup> <http://www.smartindicators.org/about.htm#Methodology>.
- <sup>7</sup> [http://www.measuredhs.com/aboutsurveys/search/search\\_surv\\_std.cfm?SrvyTp=type](http://www.measuredhs.com/aboutsurveys/search/search_surv_std.cfm?SrvyTp=type).
- <sup>8</sup> Al-Rubeyi BI. Mortality before and after the invasion of Iraq in 2003: Commentary. *Lancet* 2004; 364: 1834-5.
- <sup>9</sup> UNDP, Iraq Living Conditions Survey, <http://www.iq.undp.org/ILCS/PDF/Analytical%20Report%20-%20English.pdf> (accessed 4 Oct 2006).
- <sup>10</sup> Carl Bialik, "Counting the Civilian Dead in Iraq," *Wall Street Journal* (Aug. 5, 2005), [http://online.wsj.com/public/article/SB112309371679604061-EAfVPB24IX6gSz3wkK\\_gg0HrRvU\\_20060804.html?mod=tff\\_main\\_tff\\_top](http://online.wsj.com/public/article/SB112309371679604061-EAfVPB24IX6gSz3wkK_gg0HrRvU_20060804.html?mod=tff_main_tff_top) (accessed 4 Oct 2006).
- <sup>11</sup> "Measuring Stability and Security in Iraq," August 2006, pp. 31-34; [http://www.defenselink.mil/home/features/Iraq\\_Reports/Index.html](http://www.defenselink.mil/home/features/Iraq_Reports/Index.html), (accessed 4 Oct 2006).
- <sup>12</sup> John Daly, "Iraqi Civilian Casualties," July 12, 2005. <http://www.upi.com/archive/view.php?archive=1&StoryID=20050712-090927-2280r> (accessed 04 Oct 2006).
- <sup>13</sup> Chambers LW, Green DJ, *et al.* The experience of the US Marine Corps' Surgical Shock Trauma Platoon with 417 operative combat casualties during a 12 month period of operation Iraqi Freedom. *J Trauma*. 2006; 60(6): 1155-64.
- <sup>14</sup> O'Hanlon ME, Kamons A. Iraq Index: Tracking Variables of Reconstruction and Security in Post-Saddam Iraq. 2006. Brookings Institution. 1-67.
- <sup>15</sup> Thompson, M. "The Wounded Come Home" *Time*. 3 Nov 2003.
- <sup>16</sup> Riccitiello R. Casualty of War. <http://www.msnbc.msn.com/id/11882164/site/newsweek/> (accessed 20 Sept 2006).
- <sup>17</sup> Wounded. <http://icasualties.org/oif/Wounded.aspx> (accessed 22 Sept 2006).
- <sup>18</sup> Weisskopf, M. *Blood Brothers: Among the Soldiers of Ward 57*. New York: Henry Holt & Company, 2006.
- <sup>19</sup> Hoge CW, Auchterlonie JL, Milliken CS. Mental Health problems, Use of Mental Health Services, and Attrition from Military Services After Returning from Deployment to Iraq or Afghanistan. *JAMA*. 2006; 295: 1023-1032.
- <sup>20</sup> Hoge CW, Castro CA, *et al.* Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care. *New Eng J Med*. 2004; 351: 13-22.
- <sup>21</sup> Friedman MJ, Posttraumatic Stress Disorder Among Military returnees from Afghanistan and Iraq. *Am J Psych*. 2006; 163(4): 586-593.
- <sup>22</sup> Ascherio A, Chase R, Cote T, *et al.* Effect of the Gulf War on infants and child mortality in Iraq. *New Eng J Med*. 1992; 327: 931-936.
- <sup>23</sup> Zaidi S, Fawzi MS. Health of Baghdad's children. *The Lancet*. 1995; 346:1485.
- <sup>24</sup> UNICEF. At a glance: Iraq-The big picture. <http://www.unicef.org/infobycountry/iraq.html> (accessed Sept 10, 2006).
- <sup>25</sup> Department of Defense. Measuring Stability and Security in Iraq: report to Congress. August, 2006. p. 17.
- <sup>26</sup> UN World Food Program. Baseline food security analysis in Iraq, Rome: World Food Program, 2004.
- <sup>27</sup> Hirschfield, R. An Arab-American Priest, Depleted Uranium, and Iraq. *The Washington Report on Middle Eastern Affairs*. 2005. 24(8): 29-30.
- <sup>28</sup> USAID, 2004. Internal report.
- <sup>29</sup> MedAct. Enduring effects of War: Health in Iraq. London: 2004.
- <sup>30</sup> O'Hanlon, ME, Kamons A. Iraq Index, Brookings Institution August 2006. [www.brookings.edu/iraqindex](http://www.brookings.edu/iraqindex) (accessed 13 August 2006).
- <sup>31</sup> This Appendix and Appendix G were written by John Tirman.
- <sup>32</sup> Dexter Filkins of the *New York Times*, one of the longest serving American reporters during the war, says that "98% of Iraq, and even most of Baghdad, has now become 'off-limits' for Western journalists." *Editor & Publisher* (Sept. 16, 2006); [www.editorandpublisher.com/eandp/news/article\\_display.jsp?vnu\\_content\\_id=1003122985](http://www.editorandpublisher.com/eandp/news/article_display.jsp?vnu_content_id=1003122985) (accessed 4 Oct 2006).

- <sup>33</sup> [www.world-gazetteer.com/wg.php?x=&men=gcis&lng=en&dat=32&geo=-105&srt=npan&col=ahq&pt=c&va=x](http://www.world-gazetteer.com/wg.php?x=&men=gcis&lng=en&dat=32&geo=-105&srt=npan&col=ahq&pt=c&va=x), (accessed 22 Sept 2006).
- <sup>34</sup> In 2006, according to Central Command and Air Force Link web sites, these sorties were averaging about 1,200 or more monthly.
- <sup>35</sup> On rules of engagement, several journalistic accounts have taken this up, including Thomas E. Ricks, *Fiasco: The American Military Adventure in Iraq* (Penguin, 2006), interalia; see also Juan Cole's report on this, which includes a link to the official documents, [www.juancole.com/2005/08/us-military-rules-of-engagement-and.html](http://www.juancole.com/2005/08/us-military-rules-of-engagement-and.html) (accessed 24 Sept 2006).
- <sup>36</sup> A Khakee and H Wulf, "Following the Trail: Production, Arsenal, and Transfers of Small Arms, *HGF Review*, Spring 2005, 26-30.
- <sup>37</sup> Both polls were reported in the *Washington Post*, Sept. 26-27, 2006, and are available online. The PIPA results are available on line at <http://www.pipa.org/>.