The Human Cost of the War in Iraq

A Mortality Study, 2002-2006

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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 1800 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 5.5/1000/year pre-invasion, and overall, 13.2/1000/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

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 causalities 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.[1,2] 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.[3]

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.[4] 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.[5] 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.[6, 7]

Methods

The surveyors from the School of Medicine of Al Mustansiria 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 governates 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 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 the geographic distribution of the population in Iraq. This is known as the first stage of sampling in which the governates (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. [8]

Table 1: Province populations and cluster allocation*

Province	Mid-year 2004 population	Number of clusters
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
Total	27,072,200	47

*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 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[9]) 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 1474 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 1000 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 1000 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/1000/year, a figure which 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/1000/year
- March 2003-April 2004: 7.5 deaths/1000/year
- May 2004-May 2005: 10.9 deaths/1000/year
- June 2005-June 2006: 19.8 deaths/1000/year
- Overall post-invasion: 13.2 deaths/1000/year

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

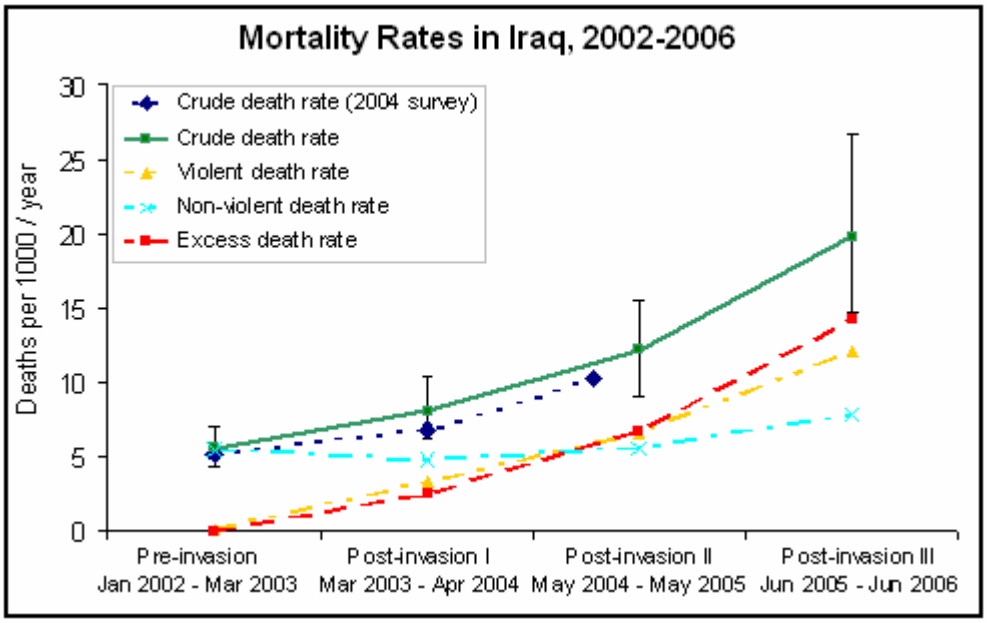

Figure 1.

Excess death rate
The rate of 5.5 deaths/1000/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/1000/year
- May 2004-May 2005: 5.6 deaths/1000/year
- June 2005-June 2006: 14.2 deaths/1000/year
- Overall post-invasion: 7 .8 deaths/1000/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/1000/year
- May 2004-May 2005: 6.6 deaths/1000/year
- June 2005-June 2006: 12.0 deaths/1000/year
- Overall post-invasion: 7.2 deaths/1000/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 a 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/1000/year for this most recent period of time, and 2.0 deaths/1000/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/1000/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 7.2/1000/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 7.2/1000. 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.

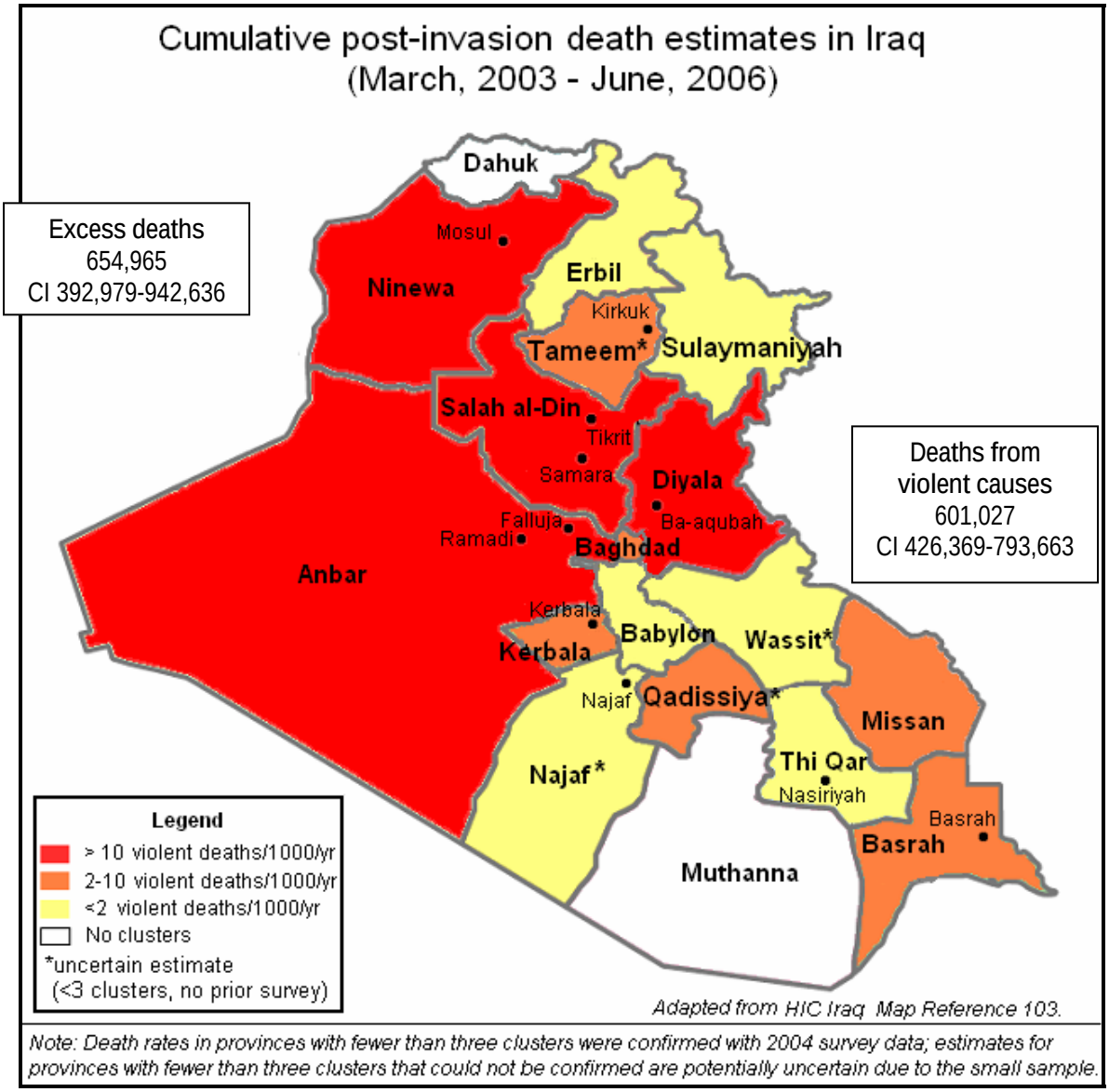

Figure 2. Death rates due to violent causes, by governate.

Weapons causing death

From the accounts of households, it was almost always possible to identify the weapon or type of ordnance 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.

Source of violence	Time Period				Total
	Pre-invasion	Mar 03 - Apr 04	May 04 - May 05	Jun 05 - Jun 06	
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/ordinance	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 deathsl	2	45	90	165	302

Table 2. Sources of violent deaths.

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.

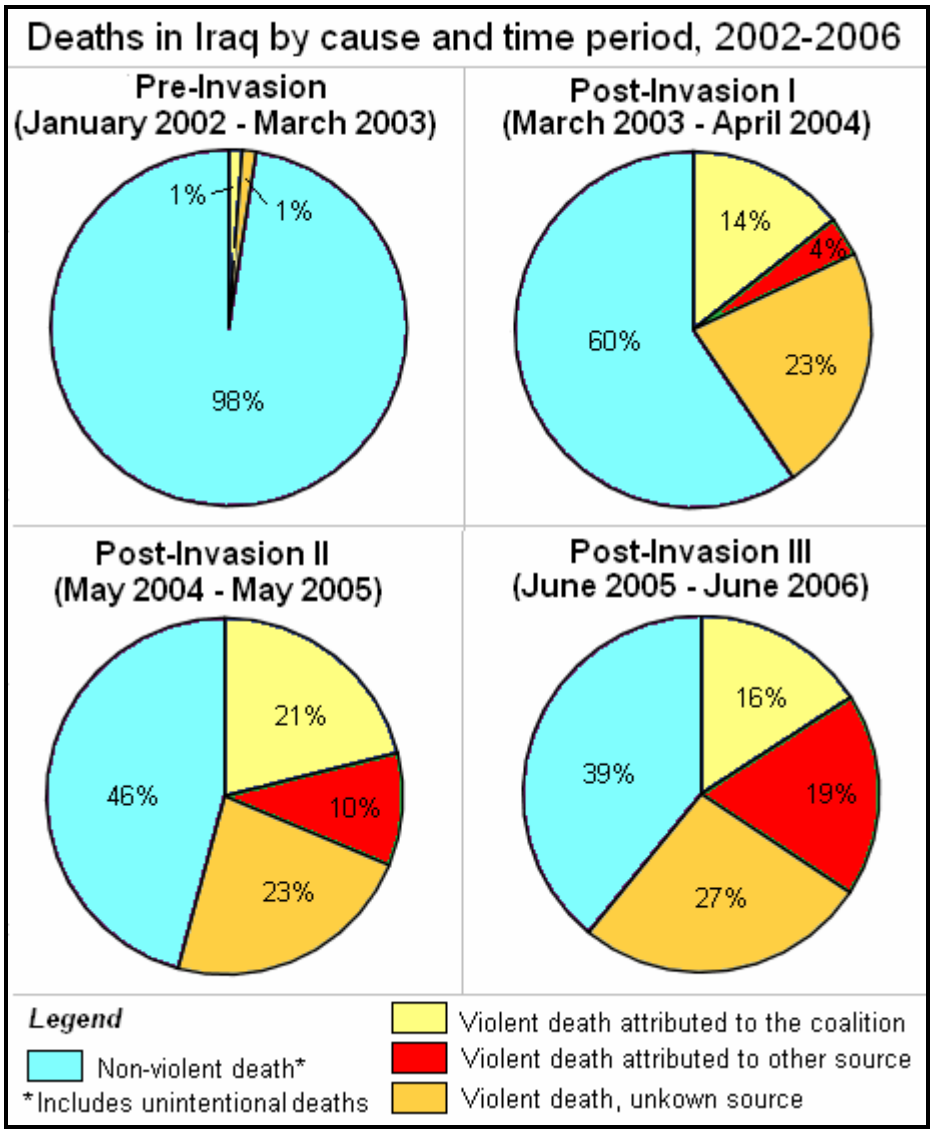

Figure 3.

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.

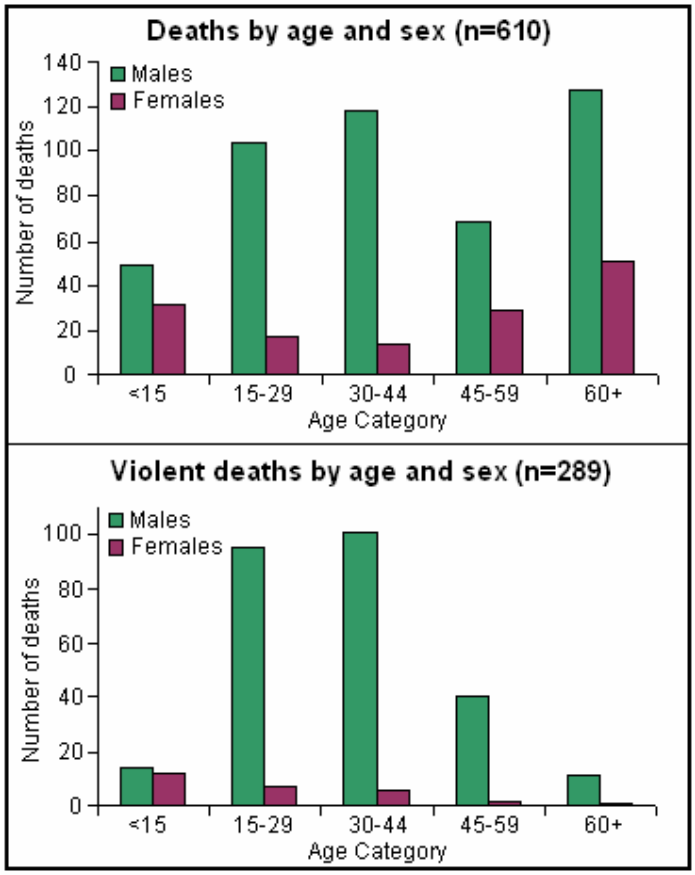

Figure 4.

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. [10,11,12,13]

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. [14,15,16] Recent estimates are that 200,000 have died in Darfur over the past 31 months.[17] 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

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