Epidemiologic impact of invasion and post-invasion conflict in Iraq

Richard Garfield[1,*], Juan Diaz[2]

[1] *School of Nursing, Columbia University, New York City, USA;*
[2] *Eastern Mediterranean Region Office, World Health Organization, Cairo, Egypt.*

SUMMARY **There has been little systematic analysis of casualty data from the Iraq invasion and post-invasion conflict since 2003. Here we combine well known sources on military casualties and little known or understood sources on non-combatant mortality to identify major trends and impacts. This conflict is unique in many ways. It is associated with high risk of death to previously little affected groups – female and older adult soldiers. From the early days of combat, the conflict has resulted in a relatively high rate of death among soldiers, reversing a long term trend toward declining mortality among U.S. troops. Despite a high survival rate among those with serious injuries, it is the first conflict for which most deaths occurred after the end of major hostilities. Deaths among non-combatant groups are much higher, and have resulted in far more confusion regarding actual mortality rates. This is not surprising; in few of the major conflicts or humanitarian crisis have epidemiologic estimates been made. It is shown that pre-invasion projections regarding civilian casualties were uniformly mistaken regarding the major risks and risk levels to be faced. More research is needed to improve and standardize approaches to identifying mortality risk to major population groups.**

Key Words: Iraq, war, non-combatants, violence, soldiers

Introduction

The most contentious large-scale conflict in the last decade has been the coalition invasion, overthrow, and post-invasion military occupation of Iraq. Information on coalition troop casualties is relatively well publicized and widely known to the public, but information on casualties to other combatants and non-combatant groups is very limited and little known. Here we present an analytical summary of both kinds of information, during several different periods, through epidemiologic analysis. To do so we draw on published and unpublished reports, comparative analysis with prior conflicts, and personal knowledge of the health and information systems from years of work in that country prior to and following the 2003 invasion. The analysis follows evolving standards in epidemiologic analysis of intentional injury by identifying rates and risks among major relevant groups, starting with those for whom the most comprehensive information is available.

Coalition military casualties

Through December 31, 2006 there were 3,247 military deaths among non-Iraqi coalition forces (Table 1 and Figure 1) (*1*). Among these, 90 percent of all deaths occurred among U.S. troops. There were an estimated 9,200 deaths among Iraqi security forces, 133 deaths among Iraqi Kurdish coalition troops, at least 400 deaths among non-Iraqi contractors, and at least 92,000 deaths among suspected insurgents in Iraq.

About 2 percent of U.S. military deaths in Iraq have been among women. Though relatively small in number, these 60 deaths are greater than in any previous U.S. war. About 22 percent have occurred among reservists or members of the National Guard, and 25 percent among non-whites. Sixty percent of these deaths occurred among those under age 25, but the 12% of deaths among those over age 35 represent the largest proportion of deaths among older adults of any U.S. war.

The injured-to-dead ratio due to combat is 7:1 (*2*).

**Correspondence to:* Richard Garfield, Box 6, 630 West 168th Street, New York, NY 10032, USA;
e-mail: rmg3@columbia.edu

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Table 1. Timeline of war in Iraq

Coalition air attacks began.	(3/20/2003)
Saddam Hussein's statue pulled down.	(4/10/2003)
Bush declares major hostilities over.	(5/1/2003)
Economic sanctions on Iraq lifted.	(5/22/2003)
First meeting of the Iraqi Governing Council.	(7/13/2003)
Saddam Hussein's sons are killed.	(7/22/2003)
UN headquarters bombed.	(8/19/2003)
Madrid donors conference pledges about $2 billion per year for reconstruction.	(9/7/2003)
First helicopter downed.	(11/2/2003)
Oil for Food Program ends.	(11/21/2003)
Saddam Hussein captured.	(12/13/2003)
Interim constitution signed.	(3/8/2004)
Elections held for 275 seat Transitional National Assembly.	(1/20/2005)
New Iraqi government approved by parliament.	(4/6/2005)
National parliamentary elections and referendum on constitution.	(12/15/2005)
Saddam Hussein executed.	(12/30/2006)

In past wars, many more of the seriously injured died, producing a much lower ratio of 5:1 or 3:1. Among these injured, there an unprecedented low rate of 1.5 percent soldiers dying of wounds in 2003 (*2*). Like in Gulf War I, a high one-third of all deaths in the first months of the war occurred from non-hostile acts. This declined to around 15% of deaths within a year. After the first relatively peaceful months after the 2003 invasion, deaths resulting from improvised explosive devices grew to comprise more than a third of all deaths overall and more than half of all deaths in 2005. Body armor containing ceramic plates is partly responsible for the low rate of injuries to the torso. Of 598 soldiers treated at the 31st Combat Support Hospital in Baghdad, 14 percent suffered torso injuries. Among Iraqi prisoner patients, the rate was nearly twice that, at 27 percent (*3*).

One hundred nineteen U.S. military personnel and 61 other international Coalition forces were killed during the period of major hostilities through April 31, 2003. For the first time in any U.S. military engagement, most deaths occurred after the period of major hostilities ended. The total number of Coalition-troop deaths has also passed the 2,000 deaths among British soldiers to occur in the post-World War I occupation of Iraq.

Iraqi military casualties

No tracking system exists for deaths among Iraqi troops as the army was disbanded after the war. A total of 4,000 deaths among Iraqi soldiers is frequently used. In addition, a reported 5,500 soldiers were missing in action (MIA) at war's end. A higher figure of 9,200 plus 1,600 was estimated by the Defense Alternatives Project (*4*). Of these, the largest number, an estimated 2,878, died in the battle for Baghdad.

Non-military casualties

Internationals: Twelve international journalists, 24 relief workers and diplomats, and about 400 foreign insurgents during major hostilities in the first 6 weeks of the invasion. By 2006, the Iraq was had become the most deadly war for journalists, surpassing the Vietnam War (*5*).

Iraqi noncombatant casualties during major hostilities

In a change from policy during previous conflicts, the U.S. military has not provided information on deaths to non-combatants either during or after the period of major hostilities in Afghanistan or Iraq. General Tommy Franks and others have frequently repeated the new military refrain, "We don't do body counts." Yet on several occasions, the military has released just such civilian casualty figures. When asked about the contradiction, General Conway in a May 10, 2005, briefing responded: "You haven't heard me mention body counts....It does add perspective, but I don't think it's something we'll do as a matter of course" (*6*). He thus admitted, as military observers already knew, that indeed they do partial body counts, they just do not consider it frequently in their interests to report them.

During and immediately following the 2003 war, all-cause mortality was high. Baghdad hospitals reported 1,100 civilian deaths to the Ministry of Health during the war before the Hussein regime fell; among another

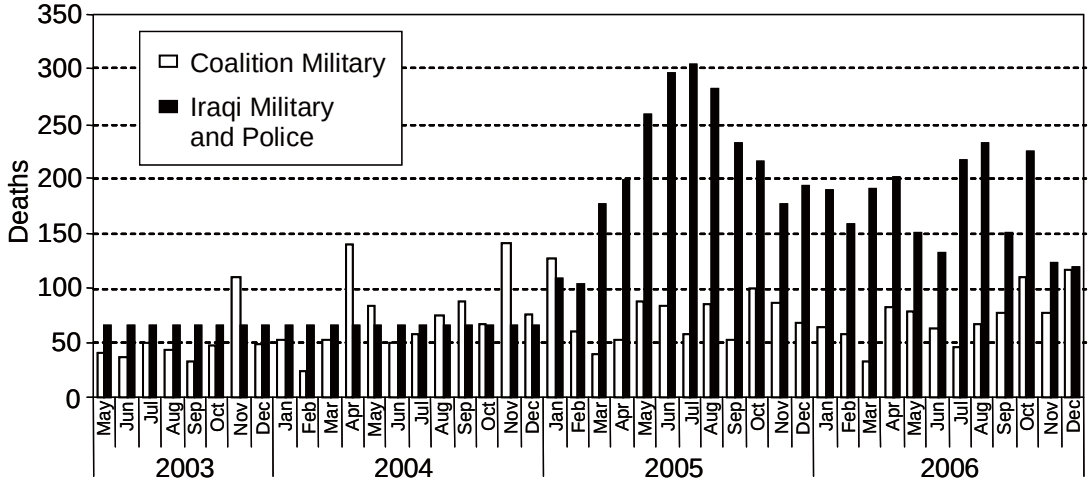

Figure 1. Coalition and Iraqi troop deaths, 3/2003 - 12/2006.

1,255 deaths it could not be determined if the dead were military or civilian (*4*). A review of hand-written reports from hospitals in the Baghdad area accounted for 1,700 war-related civilian deaths and 8,000 injuries by the time that major hostilities ended in late April (*7*). Hospitals throughout the country recorded about 2,000 war-related civilian deaths during April and May of 2003. Most Iraqi Shias are buried in the city of Najaf; there were about 2,000 extra burials during the war period (*8*). Only a fraction of these deaths were recorded the hospital system. Incident and press reports collected by Human Rights Watch account for about 700, representing about a third of these deaths. Taken together, the deaths recorded in hospitals and cemeteries exceed 4,000 deaths above normal levels during the 3 week period of major hostilities.

The Associated Press reviewed information from half of the hospitals in the country in June 2003 and accounted for a total of 3,200 civilian deaths (*9,10*). The Ministry of Health (MoH) statistical office attempted a more comprehensive accounting of civilian deaths starting in late 2003. These and subsequent efforts on civilian casualties have frequently met political interference (*11*). These data reflect that deaths recorded at hospitals may be as much as 80 percent of the total in normal times but only about half of all deaths during the period of major hostilities (*12*).

The problem is that press-based death reports are subject to undercount which cannot be estimated. As a similar evaluation in Guatemala found, the highest rate of deaths in that county's war occurred when press reports of deaths went down (*13*). Given the extremely high risk of death to journalists, press-based reports have progressively deteriorated in their ability to track a stable if small proportion of all deaths. Yet because they provide the only source for monthly monitoring of mortality trends among non-combatants, they are frequently used. The IBC database includes a minimum estimate of 3,480 deaths in March and 2,508 in April. This represents about 6,000 deaths among civilians during the period of major hostilities, or about twice the deaths recorded in hospitals and about 50 percent more deaths than were recorded in hospitals and cemeteries for this period.

Iraqi non-combatant casualties since the end of major hostilities

Excess deaths may occur from several causes. Intended or unintended victims of combat or sectarian operations are direct casualties. Many more excess deaths occur in some conflicts indirectly, as a result of injuries due to lawlessness, lack of health care, sanitation, water, or food, or inadequate access to essential goods and services due to a lack of security (*14,15*).

Apart from military engagements, there is steep rise in the number of homicides, especially those due to firearms. The average number of deaths recorded at the Baghdad morgue rose from around 200 per month before the war to 462 in May 2003, 626 in June, 751 in July, and reached 872 in August (*16*). They then leveled off at an average of around 600 per month for the following year (Figure 2). This rise was mostly the result of firearm injuries, which rose from 10 percent to more than 60 percent of the total. So called "accidental deaths" due to intoxication, burning, stabbing, road accidents, shooting, or drownings were the second most common cause, and also likely included some homicides.

Deaths recorded as homicides in the Baghdad morgue provide an indicator of trends in civil violence over time. The reported rate of homicides recorded there rose to a high of 185 per 100,000 in August 2003 (*17*). It then declined to about 100 per 100,000 in autumn and winter 2004. This represents a rate more than double that in the highest US cities and similar to rates in Colombia at its peak the early 1990s (*18*).

All count-based sources of information on non-combatant casualties are very incomplete. In 2006 the UN collected data from the central Baghdad morgue and reported hospital-based deaths due to violence, including crime (*19*). These data are about double the estimates produced by the Iraqi Body Count project's press-based reports (which exclude deaths known to be due to

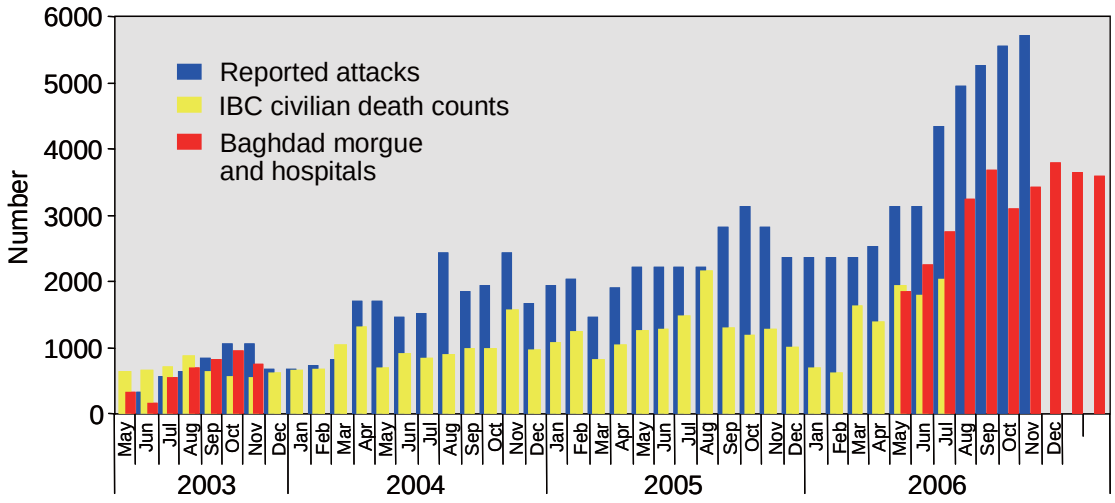

Figure 2. Count-based estimate of attacks and Iraqi non-combatant deaths.

crime (*20*)). But both sources fail to include data from many other morgues, hospitals that are not reporting, or people buried without presentation at a hospital or morgue. Two population-based sample surveys carried out interviews in 2004 to assess level of mortality. The first, the IMIRA survey carried out by the Norwegian Institute for Applied International Studies and the Central Statistical Organization (*21*) reached 21,000 homes in all 18 governorates during the April-June period using a two-stage randomization to collect a wide array of social indicator data. It reported a total of 24,000 conflict-related deaths (95%CI, 18,000-24,000) (*21*). The second involved researchers from US and Iraqi universities to assess levels and causes of mortality in the 15 months prior and the 18 months after invasion (*22*). It used a cluster sampling procedure to reach 7868 people representing 17 governorates in September and verified a sample of reported deaths by reviewing death certificates. It found a total of 98,000 excess deaths (95%CI, 8,000-194,000) of which 57,600 were deaths due to violence (Figure 3). Both studies underestimate deaths by not including households where no one has been left alive. The difference in results from these two sources is not surprising given their very different methods, training, and field supervision. But even their lowest calculated estimates are many times higher than the count-based sources.

A third survey, developed for a different purposes, interviewed returning US Army and Marine soldiers, 14 percent and 28 percent of whom reported, respectively, that they believed themselves to be responsible for the death of a noncombatant (*23*). Rates of deaths due to violence per day from these varied sources are summarized in Tables 2 and 4. None of the approaches to estimating mortality in post-invasion Iraq are able to reliably distinguish all combatant from noncombatant deaths or intentional from unintentional deaths. The social experience of excess mortality was well stated by one Iraqi observer: "We had hidden mass graves before. Now we have open mass graves," Al-Haili said. "Really, it is the same thing: We are losing our people" (*24*).

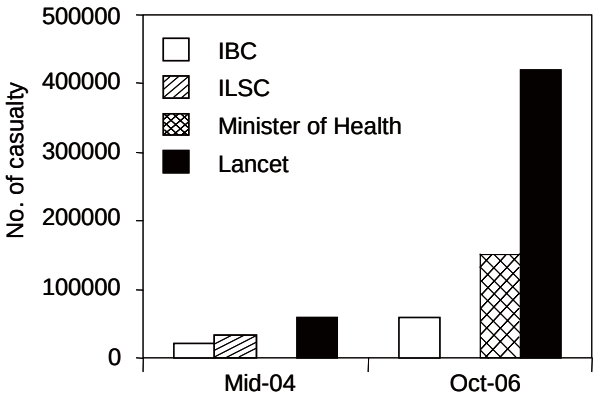

Figure 3. Civilian casualty estimates.
Sources: Iraq coalition casualty count. Accessed on December 13, 2006, at http://icasualties.org/oif/default.aspx.

The predominant cause of casualties through 2004 was actions by coalition troops. It then changed. Ministry of Health reporting during June 10-September 10, 2004, separated deaths by forces initiating violence. There were an average of 14 deaths per day by coalition-initiated actions and 6 from insurgent-initiated actions (*25*). Among this group, there were 59 deaths to children under age 12 in Anbar province, an area of major coalition attacks. In the same period there were 56 violent deaths among children in Baghdad, an area with five times more residents. The second household survey (*26*) also found that the most common cause of violent deaths in low-conflict communities was actions by coalition troops. Criminal activity and insurgent actions were the next most common causes. Far more injury deaths were reported in high-conflict Falluja in Anbar province, predominantly as a result of coalition actions.

By 2006 the level and pattern of non-combatant mortality had changed considerably. Using similar methods and a larger sample than the 2004 survey, a total of 651,000 excess deaths were estimated. This represents a level about ten times higher than the

Table 2. The state of Iraq: An update

	August, 2003	August, 2004	August, 2005	August, 2006
U.S. troop fatalities	36	65	90	63
U.S. troops wounded	181	891	608	641
Iraqi security force fatalities	65	65	282	233
Iraqi civilian deaths From violence	700	1,500	2,000	3,000
Multi-fatality bombings	4	13	27	52
Foreigners kidnapped	0	30	24	0
Internally displaced persons (since April 2003)	100,000	200,000	250,000	500,000
Attacks on oil assets	5	21	9	2
U.S./other Coalition troops in Iraq (in thousands)	139/22	140/24	138/23	140/19
Iraqi security forces (in thousands)	35	91	183	298
Iraqi security forces in top two readiness tiers(out of four; in thousands)	0	0	30	100
Oil production(in millions of barrels per day; prewar peak: 2.5)	1.4	2.1	2.2	2.2
Household and transport fuel supplies (as percentage of estimated need)	57	84	96	71
Average electricity production (in megawatts; prewar: 4,000)	3,300	4,700	4,000	4,400
Trained judges (estimated need: 1,500)	0	200	350	750
Registered cars (in millions; prewar: 1.5)	1.5	2.0	3.0	3.5
Children in school (in millions; prewar: 4.6)	4.6	4.8	5.1	5.2
Iraqis optimistic about the future (percent)	60	51	43	41

Source: Kamp N, O'Hanlon M, Unikewicz A. The State of Iraq: An Update. New York Times, October 1, 2006, p. 11.

cumulative count from the Iraqi Body Count and a shift to deaths primarily due to conflict between Iraqis rather than due to coalition forces.

Discussion

Mortality due to intentional injuries has been high since the 2003 invasion among both civilians and the military. The main cause of such deaths among civilians has changed from state-sponsored killings, to banditry and insurgency on the ground and air strikes from the air. The main cause of excess non-injury mortality has changed from lack of essential goods and infrastructure deterioration to reduced utilization and destruction of infrastructure resulting from insecurity.

The potential humanitarian consequences of the 2003 war were widely discussed in the months prior to the war. Research reports claimed that hundreds of thousands of people might starve, be killed, become victims of weapons of mass destruction, or become refugees (*3,4*). All of these estimates greatly over-estimated the mortality impact of the war on Iraqi civilians, but very seriously underestimated excess deaths and indirect effects of conflict after major combat ended.

Even conservative estimates place the number of deaths among civilians at more than 20 times greater than the number of deaths among coalition military personnel.

The resurgence of injury deaths in 2003 is unprecedented both among civilians and the military in U.S. post-war occupations. In no other conflict in a century did killing continue at such high levels (Figure 4). By September 2003, for the first time in a U.S.-led war, the total number of deaths after major hostilities ended exceeded the number during major hostilities. By January 2005, more than 90 percent of all Coalition troop deaths occurred after the end of major hostilities.

The number of coalition soldiers dying during the period of major hostilities was at an unprecedented

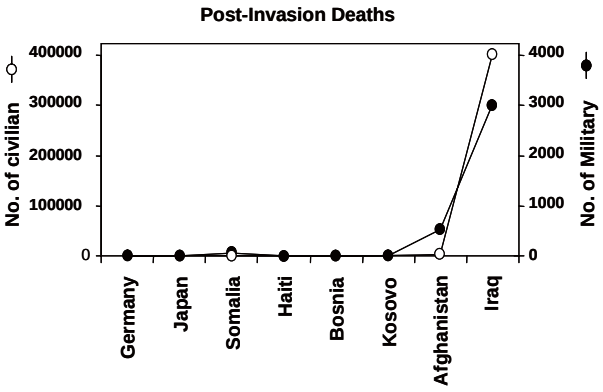

Figure 4. Deaths among civilians and military during eight occupations.

Table 3. Crude death rate among U.S. and other soldiers in various conflicts

Event	Deaths per 10,000 Soldiers Per Year	Total Deaths
World War I	142	106,700
World War II	68	407,300
Korean War	19	33,650
Vietnam War	8	58,100
Gulf War I, 1991	36	293
Gulf War II, 2003 (through 4/30/03)	119	171
Post-2003 Occupation - (4/30/03 - 12/31/04) U.S. Troops	48	1,353
Post 2003 Occupation - (4/30/03 - 12/31/04) Other Coalition Troops	40	140
Post-2003 Occupation - (4/30/03 - 12/31/04) Iraqi Security Forces	83	2,050

Sources: Garfield RM, Neugut A. Epidemiologic analysis of warfare: A historical review. JAMA 1991;266:688-692; Military casualty information http://web1.whs.osd.mil/mmid/causalty,castop,htm. Iraq coalition casualty count http://icasualties.org/oif/default.aspx, and http://www.brookings.edu/dybdocroot/fp/saban/iraq/index.pdf.

Table 4. Average number of estimated excess deaths per day, 2003 and 2004

Source	Dates Covered	Average Reported Excess Deaths per Day
Min of Health	4/5/2004 - 1/05/2004	20
Mass Bombings and Baghdad Morgue Deaths	2004	21
Interior Ministry	12/2003 - 5/2005	22
Iraqi Body Count	3/2003 - 12/31/2006	61
NGOs Committee in Iraq	Most of 2004	50
IMIRA (Norwegian)	3/1/2003 - 5/30/2004	56 (95%CI 42-69)
UN Assistance Mission for Iraq	1/1/2006 - 10/31/2006	92
Minister of Health	3/2003 - 11/2006	100
Roberts *et al.*	3/1/2003 - 9/21/2004	173 (95%CI 14-341)
of which, violent deaths		101
NEJM Mental Health Study	2003 - 2004	133
People's Kifah	3/2003 - 10/2003	152
Burham, *et al.*	3/1/2003 - 6/2006	510 (95%CI 306-740)

low in both 1991 and 2003 Iraq wars. This low number of deaths masked a resurgence in the mortality rate among U.S. soldiers. The mortality rate among soldiers since the end of major hostilities similarly exceeds that of prior U.S. wars in the last 50 years. The death rate among Iraqi security forces is about twice that of coalition troops (Table 3).

The quick response, careful assessment, and policy changes in response to 22 suicides among U.S. troops in Iraq was excellent. By contrast, there has been almost no attention to acute or chronic mental health needs of 27 million Iraqis. Following decades of political terror, family separation, repression and politicization of the very limited mental health services, the needs among Iraqis must be enormous. They remain, 3 years after the end of major hostilities, largely unknown.

A battle over the counting and representation of civilians deaths began in 2004 and has continued ever since. Non-combatant deaths seem to have become the most widely used indicator of the well-being of Iraqis in public policy debates. Unfortunately, the coalition appears to have put more effort into "spin and damage control" over the perception of civilian deaths than actions in the field to reduce these deaths. In 2005, the Bush administration started providing estimates, apparently based on IBC data, to systematically under-represent Iraqi non-combatant deaths.

The conflict in Iraq highlights the changing nature of conflict and difficulties with the definitions we use to analyze it. It is a war with no end in sight and for which no definition of an end exists. It is an undeclared war which was proclaimed to be over within weeks of the coalition invasion. It is the first war in which most of the coalition troop deaths occurred after the end of major hostilities. It represents a rising death rate compared to U.S. wars since WWII, and the highest rates of death among older adult and female coalition troops ever.

Asymmetric conflict between the world's only superpower and a little understood insurgency has generated tactics which continue to cause very high civilian casualties. New approaches and understandings for this war on terror are needed if we are to do a better job.

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