

Estimating Iraqi mortality from the Iran-Iraq war through
Operation Desert Storm, 1980-1994

Shang-Ju Li

A thesis

Submitted in partial fulfillment of the
Requirements for the degree of

Master of Public Health

University of Washington

2015

Committee:

Amy Hagopian

Abraham D. Falxman

Program Authorized to Offer Degree:

Global Health

| | |
|---|----|
| Title..... | 3 |
| Abstract..... | 3 |
| Introduction | 3 |
| Methods | 4 |
| Sibling questionnaire..... | 4 |
| Population data to calculate rates | 5 |
| Events data base..... | 5 |
| Theory behind our approach..... | 6 |
| Analysis | 6 |
| Ethical approvals..... | 6 |
| Results..... | 6 |
| Sibling survey results and national extrapolations | 6 |
| Events tabulations | 7 |
| Deaths in correlation with events..... | 8 |
| Discussion..... | 8 |
| References | 11 |
| Tables and Figures | 15 |
| Table 1. Sample size and counts of siblings in the University Collaborative Iraq Mortality Study, by governorate. | 15 |
| Table 2. Estimated Iraqi population, 1980-1993..... | 16 |
| Table 3. Counts of reported violent deaths by responsible party and by cause, by interest of time interval, as collected in the University Collaborative Iraq Mortality Study..... | 17 |
| Figure 1. Raw number of household deaths by year and cause, 1979-1993, reported by the University Collaborative Iraq Mortality Study. | 18 |
| Figure 2. Missing month of death as reported by Iraqi adults about their dead siblings in 2011 | 19 |
| Figure 3. Estimates of numbers of adult deaths per week in Iraq, 1979-1994, by cause as reported by siblings..... | 20 |
| Figure 4. Estimates of the probability of dying between age 15 and age 60, in Iraq 1979-1994, from sibling report in the University Collaborative Iraq Mortality Study National estimate of mortality deaths in Iraq 1979-1994.... | 21 |
| Figure 5. Number of <i>New York Times</i> news stories by year, 1980-1993, about Iraq and/or Iran. | 22 |
| <i>Source of data:</i> Our review of ProQuest Historical Newspapers database for NY Times articles about Iran or Iraq for the period 1980-1993. Of 31,357 articles produced, this analysis displays results for 4,769 non-duplicate events by type. | 22 |
| Figure 6. Correlation between total death and total event incidence..... | 23 |
| Figure 7. Correlation between war death and total event incidence. | 24 |
| Figure 8. Correlation between total death and war event incidence. | 25 |
| Figure 9. Correlation between war death and war event incidence..... | 26 |

Title

Estimating Iraqi mortality from the Iran-Iraq war through Operation Desert Storm, 1980-1994

By Shang-Ju Li^a, Abraham Flaxman^a, Riyadh, Lafta^b, Lindsay Galway^c, Tim Takaro^c, Gilbert Burnham^d and Amy Hagopian^a

a. University of Washington School of Public Health, Department of Global Health

b. Al-Mustansiriya University

c. Simon Fraser University

d. Johns Hopkins University

Abstract

Objectives. We calculated the Iraqi mortality rate by using sibling's survival method and triangulated it with historical literature during the conflict setting, 1980 to 1993.

Methods. We used two stages cluster sampling to select households and interviewers who reported their siblings. We used improved analysis of sibling survival data to extrapolate 45q15 and death counts from 1980 to 1993. We collected historical events from ProQuest database and generate correlation between reported death count and history incidence.

Results. In our analysis, the Iran-Iraq conflict generated an estimated 222,079 adult deaths. During the peace interval between the two wars a total of 25,418 direct war deaths were reported. Deaths associated with the Gulf War were 15,118, although 23,646 additional deaths were reported during the 8-month period immediately following the U.S. withdrawal. We found the relationship between war events in relation to total deaths. With a p-value of 0.02, we see the Spearman value is .61.

Conclusions. Despite we ask interviewers to recall 30 years formerly, sibling survival method still provides a confirmable estimation on mortality rate during the conflict setting.

Introduction

War and armed conflict threaten public health.¹ Wide-scale violence causes immediate casualties, but also creates conditions that undermine population health. Health care, transportation, communications and other infrastructure are disrupted, while shifting resources toward military and weapons systems.² As a public health surveillance responsibility, researchers need to refine methods to assess war-related morbidity and mortality.

The standard measure of public health in relation to war is mortality, although in settings where robust health information reporting persists despite war, other measures such as disability and mental health trauma would also be important to track.³ Scientists have struggled to find accurate methods to count war-related deaths when war compromises

the normal civil registration systems. In this paper, we attempt a new approach to measuring war-related mortality that covers a 30-year period in Iraq, including the Iran-Iraq war, the first Gulf War (including both the Iraq invasion of Kuwait and the brief US armed response), and the periods of relative peace bracketing those events.

The Iran-Iraq War was arguably the longest conventional war of the 20th Century, lasting 1980 to 1988.^{4,5} Almost two years of peace ensued before Iraq invaded Kuwait in early August 1990⁶ (the Gulf War), and occupied the country until the January, 1991 U.S. invasion of Iraq (Operation Desert Storm).⁷ The U.S. withdrew from Iraq in February 1991. Economic sanctions imposed under U.N. Security Council resolution 661 were imposed after the invasion of Kuwait, and continued until 2003.⁸

Population sampling approaches are the ideal method for estimating deaths from widespread conflict, in the absence of civil registration. No population survey methods have ever been attempted to estimate mortality for these wars. To fill this gap, we conducted a nationally representative cross-sectional household survey in 2011, using the sibling survival method.⁹⁻¹² To judge the accuracy of these methods with concern for such a long recall period, we collected independent data from news and historical event reports to see if sibling death reports followed expected patterns. Our research questions were: 1) *What was the war-related mortality in Iraq for the 14-year period, 1980 through 1993, which included the Iran-Iraq war and the first U.S. Gulf War?*, and 2) *Is it possible to verify sibling-reported war deaths by triangulating with independent data about violent historic events?*

Methods

Sibling questionnaire

The University Collaborative Iraq Mortality Study conducted a nationally representative cross-sectional survey of all adults living in 2000 households in 100 randomly selected clusters across Iraq in mid-2011. Data collectors traveled to 100 geographically independent, randomly selected (using population proportionate to size weighting) neighborhood clusters across Iraq to interview adults in a sample of 20 households in each cluster about all their siblings. Geographic clusters were randomly selected using Google Earth and LandScan, a commercial software that contains population data on geographic information systems, details in Galway *et al*, 2012.¹⁰

In each household, we interviewed each adult and recorded the current vital status of the sibling (alive or dead), year of birth and sex of sibling. If the sibling was dead, we recorded cause of death, year of death, location of death and if a war-related death, specific mechanism of death (explosion, gunshot, etc.), and who the suspected perpetrator was (Iraqi army, US army, criminals, etc.).

Table 1 reflects the sibling respondents to our survey by governorate, with numbers of siblings and reported deaths. Detailed information about the household survey and the mortality associated with the 2003 U.S. invasion are reported in Hagopian *et al*, 2013.¹¹

Population data to calculate rates

We used UN Population Division data for the years 1980, 1985, 1988, 1990 and 1995, available by sex and age. We linearly interpolated population data for the intermediate years, assuming linear progression between anchor points. See Table 2. We multiplied our rates of death (as reported by siblings) by total national population numbers categorized by age and sex intervals to derive total population deaths by demographic category. We then summed the deaths across these categories to derive a total adult death count for each year, 1979-1994, and report the data as a weekly death rate.

Our summary of adult mortality is *45q15*, which is the risk that an individual will die before his or her 60th birthday given that he or she has lived to age 15 years. For example, male *45q15* ranges from below .05 in a few countries to above .45 in a handful of high-mortality African nations.¹²

While most sibling reports included the month of death, many (40%) death events were only available at the level of year. If year was missing, we assumed the month of June. Sometimes this could have affected results, as, for example, the Iran-Iraq war started in September of 1980.

Events data base

To answer our second research question, we collected independent information about historic events associated with Iraq for our time period of interest. We reviewed “ProQuest Historical Newspapers: *The New York Times*,”¹³ because it had a comprehensive collection of *New York Times* articles published between 1851 and 2010. Our search was limited to the period 1980 through 1993, limiting the search to “Iraq” or “Iran.” In the field “document type,” we limited the search to “Article,” “Banner,” “Editorial,” “Front page article,” “Other,” “Legal notice,” “Military war news,” and “Review.” We excluded “Legal notice,” “Lottery numbers,” “Marriage,” “Obituary,” “Photo standalone,” “Masthead,” “Real estate transaction,” “Soldier list,” “Stock quote,” “Table of contents,” and “Weather.”

This search produced 31,357 articles. Our goal was to identify independent events in each country that could have influenced mortality, taking the broad view. We examined each article, and after eliminating reports of duplicate events, we catalogued 4,769 events. We then created an excel spreadsheet of all 4,769 unique events and created columns to tag each event as to month and year, location, type, and actors involved.

To catalogue location categories, we divided events between Iran and Iraq, and when in Iraq, we identified which governorate (using the same codes we used in our sibling mortality data set). We also had a column for region when the location was not precise.

Types of events were categorized 11 ways: war-related (including weapons mobilization, troop mobilization and armed conflict), violent political unrest, hostage-taking, humanitarian intervention, domestic political event, elections, cross-national diplomatic events, policies or actions regarding the extraction of natural resources (e.g., oil), financial news, and natural disasters.

Theory behind our approach

Our hypothesis was that adult siblings in 2011 would reasonably accurately report deaths of their siblings, even when deaths were 30 or more years ago. To assess this theory, we reviewed independent reports of war and other mortality-related events in media reports over the period. We hypothesized that when higher numbers of reports of deaths were reported in the media, our sibling respondents would, correspondingly, report more deaths.

Analysis

Estimates of mortality using the sibling survival method are subject to predictable biases.^{9,14-16} Sibships that experience a higher mortality risk are underrepresented at the time of the survey, because these siblings are less likely to survive to be able to report (survival bias). Additionally, larger sibships are overrepresented in the sample, because there are more siblings in the sampling frame. We used current methods to adjust for these biases.^{9,11} Briefly, we estimated directly the number of likely missing sibling deaths from the sample by age and sibship size through iteration for sibship sizes of one and two. We then added back these missing siblings to the observed sample before calculating final age-specific mortality rates.

To assess our theory that we could roughly corroborate sibling death reports by triangulating them with the volume of reported news events, we conducted linear regression analysis to determine the association between number of news events and number of reported sibling deaths. We compare total events to total deaths, war events to total deaths, total events to war deaths, and war events to war deaths. For each regression, we calculated a coefficient to assess the slope of the best-fit line between events and deaths. Each regression also produced a Spearman correlation and P-value.

We used Python 2.7 for all analyses.

Ethical approvals

A review board from each participating institution approved the collection of sibling death data in our household survey.¹¹

Results

Sibling survey results and national extrapolations

We interviewed 4,287 adult Iraqis in 1,960 households who reported on the vital status (alive or dead) of their 24,759 siblings. On average, siblings reported having 5.8 total brothers and/or sisters. The average adult reported 0.6 dead siblings (n=2,516 dead). Of the total dead, 65% were male (1,641). Most siblings were able to report a cause of death for their deceased family member (94%). In applying the zero-survivor correction, 7.21 missing siblings were added to the data set after three iterations.

Raw deaths from sibling reports are reflected in Figure 1, illustrating total deaths by cause by year. After applying the death rates we found in our sample of Iraqi adults to the age-, time-, sex-specific UN population totals, we estimated the aggregate number of

deaths among adults aged 15-60 years, between 1980 to 1993, totaled 545,744. War violence-related deaths comprised more than half of deaths over the time period, at 53%.

Figure 2 illustrates the number of missing month of death as reported in our study. The percentage of missing month of death in our interest of study ranges from 40% to 60% except year 1983, 1986 and 1993.

Total annual deaths per week in relation to important time periods are reported in Figure 3. The Iran-Iraq conflict (Sept. 1980 through Sept. of 1988) generated an estimated 222,079 adult deaths (ages 15-60), according to calculations based on our sibling reports. During the peace interval between the two wars (December 1988 through August 1990), a total of 25,418 direct war deaths were reported. These deaths largely occurred during the months immediately following the Iran-Iraq war, likely resulting from injuries incurred during the months before the conflict formally ended.

Deaths associated with the Gulf War were 15,118 (over a six-month period), although 23,646 additional deaths were reported during the 8-month period immediately following the U.S. withdrawal, presumably as the result of injuries that eventually resulted in death. An additional 954 direct Gulf-war deaths occurred between 1992 and 1994, again, presumably from injuries that resulted in later deaths.

Figure 4 reports the probability of death before an individual's 60th birthday given that he or she has lived to age 15 years in Iraq, mapped against the known historical war-related events. Female death reports rose to their highest levels during the city bombing campaign and the period just prior to the invasion of Kuwait. The only time female mortality exceeded male was in 1984 when the war shifted to the Gulf waters and again just before the Kuwait invasion. Male and female mortality reports were identical during the period between the end of the Iran Iraq war and the start of the Kuwait war.

Iran-Iraq direct war deaths were largely attributable to gunshots (41%) and airstrikes (17%). Most adult siblings could not name a particular responsible party for these direct war deaths. See Table 3.

Of non-war related deaths during the entire time period (1980-1993) nearly one in four (23%) were injury related, and a similar number (24%) were cardiovascular in nature. About 11% were cancer related, and another 11% were neonatal.

Events tabulations

We identified 4,769 independent, potentially war-related, events from among the 31,357 articles produced by the search terms in our search of the ProQuest database of New York Times reports.¹³

We coded 1,905 (40.5%) of events as directly war-related (including weapons mobilization, troop mobilization and armed conflict). We coded 329 events as violent political unrest, hostage-taking, humanitarian intervention, or domestic political events in

Iraq. We marked 30 election event reports in Iraq, and tagged 2,206 cross-national diplomatic events. Another 507 events related to policies or actions regarding the extraction of natural resources (e.g., oil). There were 449 events in the news related to financial events, and another 28 related to natural disasters. More than half of events were associated with Iraq (52%). We recorded 52 actors associated with each event. More than half were also associated with Iran (54%). About 22% were associated with the United States, and 10% with the United Nations. We allowed up to two actors for each event. Raw events data are reported by cause and year in Figure 5.

Deaths in correlation with events

We hypothesized that sibling deaths reported in 2011 would be reasonably accurate, even though siblings relied on a long recall period for these earlier deaths. To assess this theory, we elected to review independent reports of war and other mortality-related events in media reports over the period. We hypothesized that higher numbers of media reports, especially war-related reports, would be associated with more sibling deaths.

Figure 6 portrays total events in our database for the period 1980 through 1993 in relation to total deaths reported by siblings. We find a Spearman correlation of 0.44, although our p-value exceeds 0.10, and therefore we cannot reliably conclude there is a relationship between total events and deaths. Figure 7 shows the relationship between total events and direct war deaths (as a subset of total deaths), finding very little correlation.

Figure 8 illustrates the relationship between war events (as a subset of total events) in relation to total deaths, and here we find a more promising correlation. With a p-value of 0.02, we see the Spearman value is .61. Figure 9 shows a relatively strong relationship between war events and direct war deaths (Spearman = 0.51), although the p-value is marginal at 0.06. We conclude that more war reports by journalists are associated with more deaths reported by adults in Iraq.

Discussion

The origins of Iran-Iraq war are rooted in colonialism and territorial control of resources, fueled by religion and long-standing cultural divides.¹⁷⁻²⁰ The U.S. has interests in the region related to oil and ideology,²¹⁻²⁶ and has variously supported one regime over another and even has switched sides from time to time. A variety of weapons have been employed in the pursuit of the war, including chemical agents.^{26,27} The citizenry of both Iran and Iraq has been in harm's way for decades. Our goal as public health researchers was to identify a method of estimating direct war mortality for the Iran-Iraq war (1980-1988) and the Gulf War (1990-1993) that could have implications for other long-term conflicts.

The most in-depth analysis of the Iran-Iraq war is arguably Dilip Hiro's 1989 book, *The Longest War*.²⁸ He names sources claiming the most conservative Western estimate of Iran-Iraq war deaths is 367,000 (with Iraq accounting for 105,000) and another 700,000 injured across both countries. Rob Johnson's 2001 book, *The Iran-Iraq War*, claims 200,000 Iraqis deaths, with 400,000 wounded and 70,000 prisoners.²⁷ By contrast, the

siblings in our study reported somewhat higher death rates, resulting in estimates of 222,000 Iraqi adults dying of direct war causes (direct and indirect) during the Iran-Iraq war, and another 25,000 in the immediate post-war period (not including those younger than 15 or older than 60).

Previous estimates of deaths associated with the first U.S. Gulf War have varied widely. A U.S. Census demographer, Beth Osborne Daponte, estimated 100,000 Iraqi deaths were associated with the first U.S. invasion.²⁹ A military analyst, Trevor DuPuy, estimated about half that. Ramsey Clark estimated 25,000 Iraqi civilians died during U.S. bombings of southern Iraq, not including another 25,000 indirect deaths. In addition, 150,000 more died by 1992, he estimated.²⁹

Our surviving sibling report study generated death rates for the Iraq invasion of Kuwait and the subsequent U.S. invasion of southern Iraq (August 1990 to December 1991) that allow us to estimate 84,400 total adult deaths (ages 15-60), with 38,000 attributable to direct war injuries. Given the wide range of uncertainty for estimates associated with this conflict, our estimates are probably not unreasonable.

The Iraqi adults in our study reported deaths in a temporal pattern that coincides to a large extent with the pattern of war-related events during the period. Iraq invaded Iran in September of 1980, prior to which death reports were at a relatively low level. Both total and direct war death reports grew in the years immediately following the invasion, but fell as both Iraq and Iran accepted UN-mediated agreement and moved their theater of operations to the southern Gulf waters.

As the war moved from the water to the cities, however, mortality reports by our siblings grew. An on-again, off-again ceasefire arrangement was established in 1987, after which death reports fell again. The bombing of cities in both countries began the next year, after Iran failed to capture Basrah in an offensive operation, and deaths rose again. In the year 1989, a year with no declared war, deaths were at their lowest point since the beginning of our study period.

Death reports in 1990 rose again, however, as Saddam Hussein mobilized for the invasion of Kuwait in August of 1990. When the U.S. conducted its Operation Desert Storm invasion of Iraq in January of 1991, sibling death reports more than doubled. For the years following the U.S. withdrawal (1992 to 1994), deaths were at quite low levels. Sanctions, however, were reported to have had deadly effects throughout the 1990s, beyond the period of our study.³⁰⁻³⁴

Even though the buildup and the involvement of U.S. troops in Iraq for the period August 1990 through March of 1991 consumed less than a year, adult deaths (age 15-60) associated with it were quite high, significantly exceeding the deaths even associated with the Iran-Iraq war's city bombing campaign.

In an unexpected finding, non-war deaths reportedly increased in the months just before both wars started. There are two possible explanations; one is an artifact of the reporting

problem of missing month of death set to June (the Iraq-Iraq war started in September, and the Gulf War started in August), the other is that increased deaths are an indicator of the mobilization for war can be an Iran-Iraq War and the Persian Gulf War.

The strict application of a sibling survival method requires interviewees to recall their sibling's death with correct year of death, year of birth and type of death. Recall bias introduces error into these reports, of course, and one study in Senegal specifically suggested interviewees were more inclined to forget their married sisters.¹⁵ Helleringer *et al* improved the sibling survival method with interviewer training, the use of a historical events calendar, and allowing interviewees free recall with interviewer prompts.¹⁶ Our interviewers used an events calendar with widely known temporal reference points.

We used the most recent recommendations for adjusting calculations to the method, resulting in only a modest 7.21 missing siblings for our zero-survivor correction. Because family size is large in Iraq, fewer corrections were required for small family size.^{35,36}

Immigration bias is another possibility. Iraq used to be a high labor influx country, and young, male foreigners often started their families in Iraq. It's estimated five million refugees, including non-citizen migrants, exited Iraq at the start of the Persian Gulf War.³⁵ Because the former immigrants left few siblings behind to report, many of their deaths would not be counted.^{35,37}

Our use of incident reports in the media as an indicator of war intensity introduces a novel verification scheme, previously untested or reported. We believe this innovation shows promise in settings where historical events may not be as detailed by reliable scholars. Because the war-related reports illustrated a significant relationship to independent sibling death reports, we believe the method hold promise. It is intriguing that direct war deaths and total deaths did *not* rise in relation to counts of non-war events in our data set. To our knowledge, no previous attempts to count and categorize media events over the course of a war has been attempted, nor has anyone attempted to use these counts to corroborate household reports of deaths for a time period exceeding 30 years.

The Iraq Body Count is an attempt to measure direct war deaths using media and other accounts to simply tally civilian war fatality incidents.³⁸ Using news and other official reports beginning with the U.S. invasion of Iraq in 2003, the Body Count has enumerated 211,000 civilian violent direct war deaths, however the organization has made no similar attempt to count deaths for the period of our study, 1980-1993. It also does not count indirect deaths. The IBC has been critiqued for conflicts of interest, as well as using non-epidemiological methods.³⁹

Using a similar method to IBC in reverse (that is, verifying the magnitude and pattern of deaths reported in a population survey using news reports rather than using news reports to enumerate the dead) we attempted to tally news reports of deaths for the period 1980-1988, after eliminating duplicate reports. In perhaps a similar vein, Collinson *et al* reported on deaths of media workers in Iraq during the 2003-2012 period, which

corresponded with overall civilian death patterns.⁴⁰ No similar attempt has been made to report media worker deaths for our study period in this paper.

More than half of adult across the study period were direct war deaths. Adults between 15-60 have no “natural” causes of death. We conclude the Iran-Iraq war led to nearly a quarter of a million avoidable adult deaths, and the Gulf War generated another 40,000 unnecessary deaths. We have contributed a novel research method to verifying traditional epidemiological methods to estimate direct war mortality dating back several decades.

References

1. Murray CJ, King G, Lopez AD, Tomijima N, Krug EG. Armed conflict as a public health problem. *BMJ*. 2002;324(7333):346.
2. Sidel VW. War, terrorism and the public's health. *Med Confl Surviv*. 2008;24(sup1):S13-S25. doi:10.1080/13623690801957315.
3. Garfield RM, Neugut AI. Epidemiologic analysis of warfare. A historical review. *JAMA*. 1991;266(5):688-692.
4. Dodds J, Wilson B. The Iran-Iraq War: Unattainable Objectives. *Middle East Rev Int Aff*. 2009;13. <http://www.rubincenter.org/2009/06/dodds-wilson-2009-06-06/>. Accessed May 4, 2015.
5. *Resolution 598 (1987)*. United Nations, The Security Council; 1987. <http://daccess-ods.un.org/TMP/8380998.96907806.html>.
6. Reuters. The Iraqi Invasion; In Two Arab Capitals, Gunfire and Fear, Victory and Cheers. *The New York Times*. <http://www.nytimes.com/1990/08/03/world/the-iraqi-invasion-in-two-arab-capitals-gunfire-and-fear-victory-and-cheers.html>. Published August 3, 1990. Accessed May 4, 2015.
7. WAR IN THE GULF: THE PRESIDENT; Transcript of the Comments by Bush on the Air Strikes Against the Iraqis. *The New York Times*. <http://www.nytimes.com/1991/01/17/us/war-gulf-president-transcript-comments-bush-air-strikes-against-iraqis.html>. Published January 17, 1991. Accessed May 4, 2015.
8. *Resolution 661 (1990)*. United Nations, The Security Council; 1990. [http://daccess-ods-un.org/doc/RESOLUTION/GEN/NR0/575/11/IMG/NR057511.pdf?OpenElement](http://daccess-ods.un.org/doc/RESOLUTION/GEN/NR0/575/11/IMG/NR057511.pdf?OpenElement).
9. Alison Levin-Rector, Rajaratnam J, Wang H, Schumacher A, Levitz C. Improved analysis of sibling survival data taking into account survivor bias, zerosurviving

- reporters and recall bias. In: Murray C, Lopez A, Wang H, editors. Mortality estimation for national populations: methods and applications. *Univ Wash Press*. 2012.
10. Galway LP, Bell N, Al S SAE, et al. A two-stage cluster sampling method using gridded population data, a GIS, and Google Earth™ imagery in a population-based mortality survey in Iraq. *Int J Health Geogr*. 2012;11(1):12.
 11. Hagopian A, Flaxman AD, Takaro TK, et al. Mortality in Iraq associated with the 2003–2011 war and occupation: findings from a national cluster sample survey by the University Collaborative Iraq Mortality Study. *PLoS Med*. 2013;10(10):e1001533.
 12. Rajaratnam JK, Marcus JR, Levin-Rector A, et al. Worldwide mortality in men and women aged 15–59 years from 1970 to 2010: a systematic analysis. *The Lancet*. 2010;375(9727):1704-1720.
 13. ProQuest Historical Newspapers: The New York Times. <http://search.proquest.com/hnpnewyorktimes/history/fromBasicHomePage?accountid=14784>. Accessed May 11, 2015.
 14. Gakidou E, King G. Death by survey: estimating adult mortality without selection bias from sibling survival data. *Demography*. 2006;43(3):569-585.
 15. Helleringer S, Pison G, Kanté AM, Duthé G, Andro A. Reporting Errors in Siblings' Survival Histories and Their Impact on Adult Mortality Estimates: Results From a Record Linkage Study in Senegal. *Demography*. 2014;51(2):387-411. doi:10.1007/s13524-013-0268-3.
 16. Helleringer S, Pison G, Masquelier B, et al. Improving the Quality of Adult Mortality Data Collected in Demographic Surveys: Validation Study of a New Siblings' Survival Questionnaire in Niakhar, Senegal. Kruk ME, ed. *PLoS Med*. 2014;11(5):e1001652. doi:10.1371/journal.pmed.1001652.
 17. Karsh E, International Institute for Strategic Studies. *The Iran-Iraq War: A Military Analysis*. London: International Institute for Strategic Studies; 1987.
 18. Karsh E. Geopolitical Determinism: The Origins of the Iran-Iraq War. *Middle East J*. 1990;256-268.
 19. Johnson R. *The Iran-Iraq War*. Houndmills, Basingstoke, Hampshire; New York: Palgrave Macmillan; 2011.
 20. Nonneman G, Karsh E, Hiro D. The Iran-Iraq War: Impact and Implications. *Int Aff R Inst Int Aff 1944-*. 1990;66(2):420. doi:10.2307/2621448.

21. Marshall E. Iraq's Chemical Warfare: Case Proved: A U.N. team found mustard and nerve gas bombs on the battlefield; now the challenge is to prevent the war from spreading. *Science*. 1984;224(4645):130-132. doi:10.1126/science.224.4645.130.
22. Evison D, Hinsley D, Rice P. Regular review: chemical weapons. *BMJ*. 2002;324(7333):332.
23. Salamati P, Karbakhsh M, Sadeghian S, Togha M, Rostami M. Health status in Iran. *Maghreb Rev*. 2009;34:4-17.
24. Abbas F. Report of the specialists appointed by the Secretary-General of the United Nations to investigate allegations by the Islamic Republic of Iran concerning the use of chemical weapons. *Arch Belg Belg Arch*. 1984;Suppl:302-310.
25. Dunn P. The chemical war: journey to Iran. *Nucl Biol Chem Def Technol Int*. 1986;1(1):29-30.
26. Razavi SM, Farhad Shokraneh MD, Laal M, Ali Khaji MD, Vafa Rahimi Movaghar MD. Mortality and Injuries among Iranians in Iraq-Iran War: A System-atic Review. *Arch Iran Med*. 2013;16(9):542.
27. Zargar M, Araghizadeh H, Soroush MR, Khaji A. Iranian casualties during the eight years of Iraq-Iran conflict. *Rev Saude Publica*. 2007;41(6):1065-1066.
28. Hiro D. *The Longest War: The Iran-Iraq Military Conflict*. London: Grafton Books; 1989.
29. Bloom S. *Hidden Casualties: Environmental, Health, and Political Consequences of the Persian Gulf War*. San Francisco, CA; Berkeley, Calif.: ARC/Arms Control Research Center ; North Atlantic Books; 1994.
30. Ali MM, Shah IH. Sanctions and childhood mortality in Iraq. *The Lancet*. 2000;355(9218):1851-1857.
31. Ascherio A, Chase R, Cote T, et al. Effect of the Gulf War on infant and child mortality in Iraq. *N Engl J Med*. 1992;327(13):931-936.
32. Ali M, Blacker J, Jones G. Annual mortality rates and excess deaths of children under five in Iraq, 1991-98. *Popul Stud*. 2003;57(2):217-226. doi:10.1080/0032472032000097119.
33. Blacker J, Ali MM, Jones G. A response to criticism of our estimates of under-5 mortality in Iraq, 1980-98. *Popul Stud*. 2007;61(1):7-13. doi:10.1080/00324720601122031.
34. Daponte BO, Garfield R. The effect of economic sanctions on the mortality of Iraqi children prior to the 1991 Persian Gulf War. *Am J Public Health*. 2000;90(4):546.

35. Omran AR, Roudi F. The Middle East population puzzle. *Popul Bull.* 1993;48(1).
36. United Nations., Economic and Social Commission for Western Asia. Demographic and related socio-economic data sheets for countries of the Economic and Social Commission for Western Asia. *Demogr Relat Socio-Econ Data Sheets Ctries Econ Soc Comm West Asia.* 1985.
37. Arya N, Zurbrigg S. Operation Infinite Injustice: impact of sanctions and prospective war on the people of Iraq. *Can J Public Heal Can Santee Publique.* 2003:9-12.
38. Iraq Body Count. *Medium.* <https://www.iraqbodycount.org>.
39. Ahmed N. How the Pentagon is hiding the dead. *Medium.* <https://medium.com/@NafeezAhmed/how-the-pentagon-is-hiding-the-dead-862a7b45ce57>. Accessed May 11, 2015.
40. Collinson L, Wilson N, Thomson G. Violent deaths of media workers associated with conflict in Iraq, 2003–2012. *PeerJ.* 2014;2:e390. doi:10.7717/peerj.390.

Tables and Figures

Choose 4.

Table 1. Sample size and counts of siblings in the University Collaborative Iraq Mortality Study, by governorate

| Governorate | Number of Clusters | Proportion of sample | Number of Adults Reporting on Siblings | Number of Unique Siblings Reported | Percent of Siblings Missing Cause of Death |
|------------------|--------------------|----------------------|--|------------------------------------|--|
| Al-Anbar | 7 | 0.07 | 375 | 2,540 | 0.12% |
| Al-Basrah | 8 | 0.08 | 335 | 1,908 | 0.05% |
| Al-Muthanna | 1 | 0.01 | 61 | 371 | 0.27% |
| Al-Najaf | 2 | 0.02 | 68 | 398 | 0.51% |
| Al-Qadisiya | 4 | 0.04 | 234 | 1,366 | 0.15% |
| Al-Sulaimaniya | 7 | 0.07 | 291 | 1,822 | 0.22% |
| Babylon | 3 | 0.03 | 154 | 877 | 0.23% |
| Baghdad | 23 | 0.23 | 1066 | 5,442 | 0.17% |
| Diala | 5 | 0.05 | 183 | 1,050 | 0.19% |
| Duhouk | 2 | 0.02 | 98 | 606 | 0.00% |
| Erbil | 9 | 0.09 | 357 | 2,055 | 0.10% |
| Kerbela | 2 | 0.02 | 109 | 607 | 0.33% |
| Kirkuk | 2 | 0.02 | 98 | 502 | 0.00% |
| Maysan | 3 | 0.03 | 118 | 704 | 0.00% |
| Ninevah | 13 | 0.13 | 467 | 2,846 | 0.04% |
| Salah Al-Deen | 3 | 0.03 | 111 | 669 | 0.30% |
| Thi Qar | 3 | 0.03 | 105 | 672 | 0.00% |
| Wasit | 3 | 0.03 | 120 | 730 | 0.00% |
| All governorates | 100 | 100% | 4350 | 25,165 | 0.13% |

Table 2. Estimated Iraqi population, 1980-1993.

| Year | Source of Data | Male population | Female population | Total population |
|------|----------------|-----------------|-------------------|------------------|
| 1980 | UNDOP | 6972416 | 6680942 | 13653358 |
| 1981 | interpolated | 7153511.6 | 6884453.98 | 14037965.58 |
| 1982 | interpolated | 7334607.2 | 7087965.96 | 14422573.16 |
| 1983 | interpolated | 7515702.8 | 7291477.94 | 14807180.74 |
| 1984 | interpolated | 7696798.4 | 7494989.92 | 15191788.32 |
| 1985 | UNDOP | 7877894 | 7698501.9 | 15576395.9 |
| 1986 | interpolated | 8016200 | 7744200.6 | 15760400.6 |
| 1987 | interpolated | 8154506 | 7789899.3 | 15944405.3 |
| 1988 | UNDOP | 8,292,812 | 7,835,598 | 16,128,410 |
| 1989 | interpolated | 8559618 | 8263347.5 | 16822965.5 |
| 1990 | UNDOP | 8,826,424 | 8691097 | 17517521 |
| 1991 | interpolated | 9116776.6 | 8969867.8 | 18086644.4 |
| 1992 | interpolated | 9407129.2 | 9248638.6 | 18655767.8 |
| 1993 | interpolated | 9697481.8 | 9527409.4 | 19224891.2 |

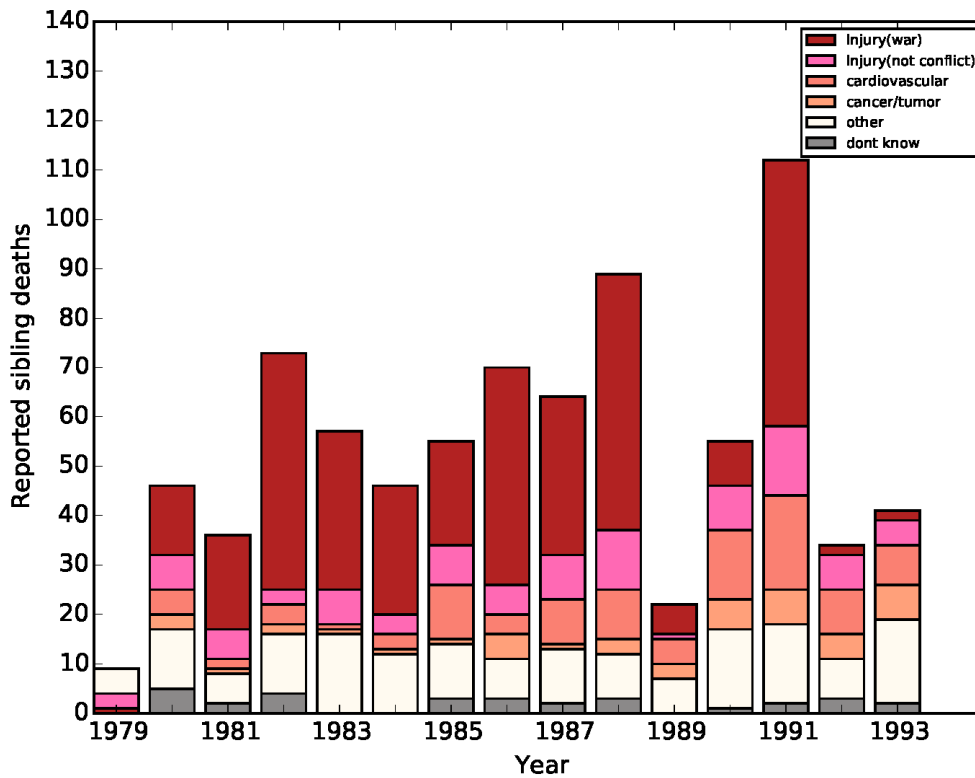
190.
s and

Table 3. Counts of reported violent deaths by responsible party and by cause, by interest of time interval, as collected in the University Collaborative Iraq Mortality Study

| Sub-Category | Time Period | | | | Total count | Percentage for 1980-1993 |
|--|---------------|-------------------|------------------|-------------|-------------|--------------------------|
| | Iran-Iraq War | Peaceful interval | Persian Gulf War | Aftermath | | |
| | 1980 -1988 | 1989 | 1990 - 1991 | 1992 - 1993 | | |
| Responsible part for violent deaths (Source: household reports) | | | | | | |
| Coalition forces | 1 | 0 | 20 | 0 | 21 | 5.8% |
| Militia | 2 | 1 | 6 | 2 | 11 | 3% |
| Criminals | 2 | 1 | 1 | 0 | 4 | 1.1% |
| Iraq army | 25 | 1 | 17 | 0 | 43 | 11.9% |
| Iraq police | 36 | 1 | 11 | 0 | 48 | 13.2% |
| Other/unknown | 221 | 2 | 9 | 2 | 234 | 64.8% |
| All responsible parties | 287 | 6 | 64 | 4 | 361 | 100% |
| Cause of violent deaths (Source: household reports) | | | | | | |
| Gunshot | 119 | 3 | 20 | 1 | 143 | 39.6% |
| Car bomb | 0 | 1 | 1 | 0 | 2 | 0.6% |
| Airstrike | 50 | 1 | 17 | 1 | 69 | 19.1% |
| Road accident | 5 | 0 | 1 | 0 | 6 | 1.7% |
| Other explosion | 26 | 0 | 3 | 0 | 29 | 8% |
| Other war injury/don't know | 87 | 1 | 22 | 2 | 112 | 31% |
| All cause | 287 | 6 | 64 | 4 | 361 | 100% |

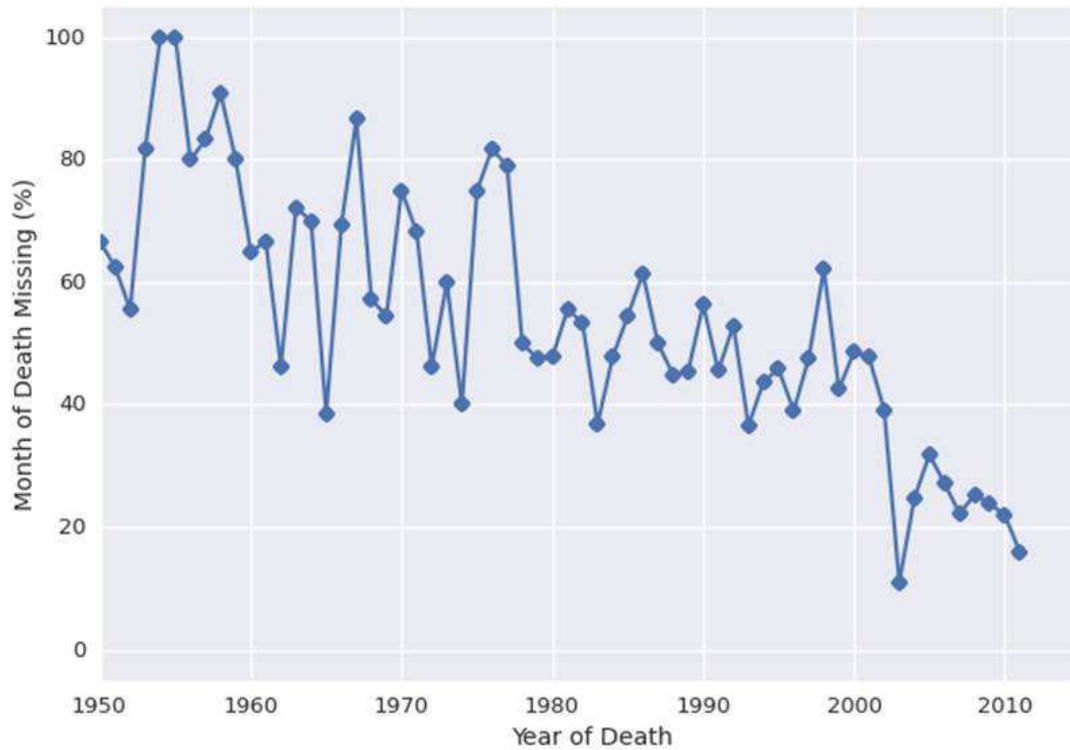
/ith

Figure 1. Raw number of household deaths by year and cause, 1979-1993, reported by the University Collaborative Iraq Mortality Study.



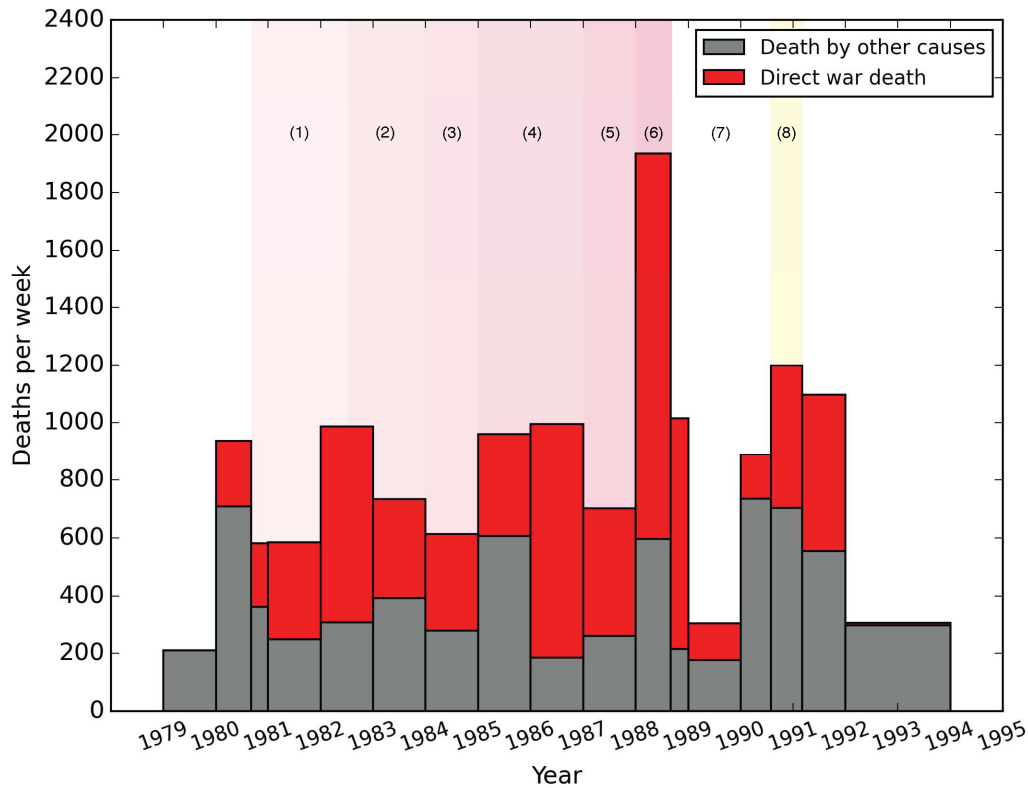
Source of data: Survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study.

Figure 2. Missing month of death as reported by Iraqi adults about their dead siblings in 2011



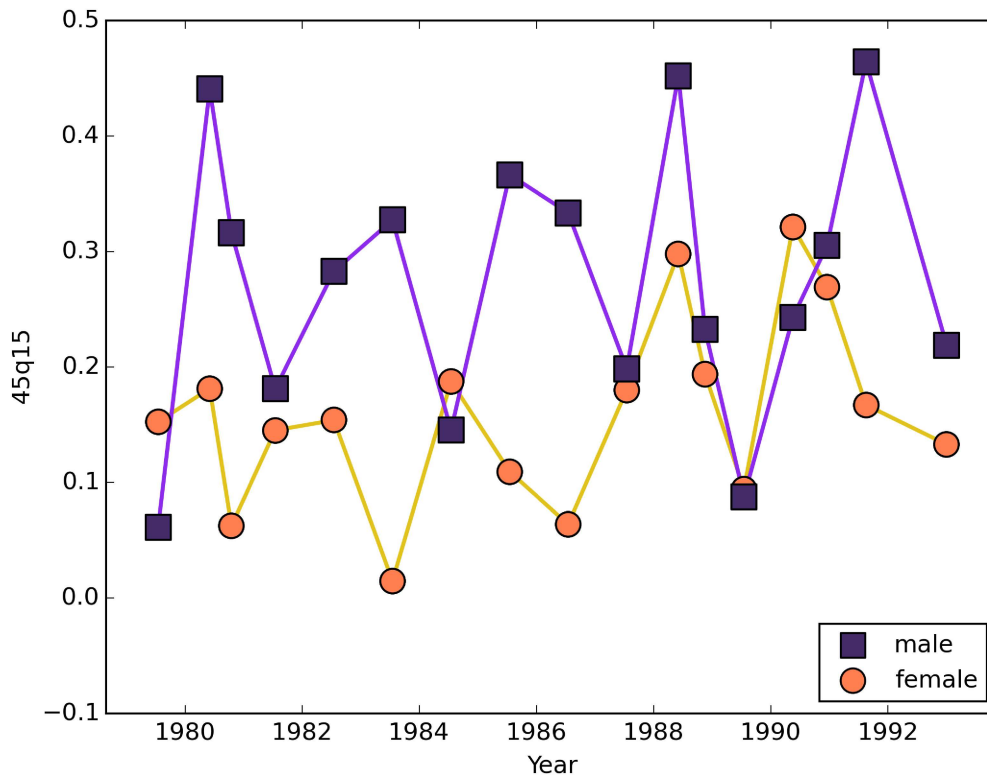
Source of data: Month of sibling death reports come from a survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Stud

Figure 3. Estimates of numbers of adult deaths per week in Iraq, 1979-1994, by cause as reported by siblings.



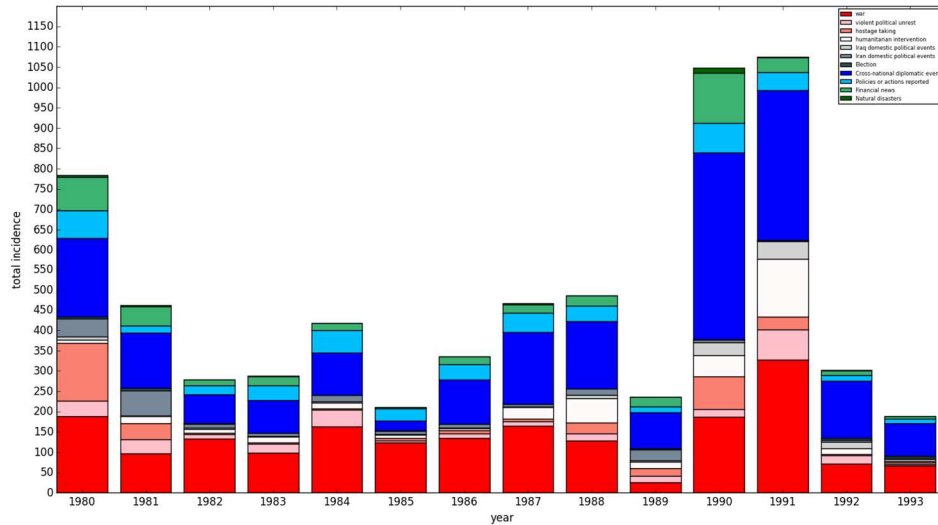
Source of data: Survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study. The vertical shading illustrates historical periods: (1) Iraqi invasion (Sep 1980-Jun 1982), (2) Iraqi retreat and Iranian offensive (Jul 1982-1983), (3) “Tanker war,” (1984) (4) border skirmishes (1985-1986), (5) toward ceasefire (1987), and (6) the intensive bombing and other assaults on cities (Jan-Aug 1988). Period (7) indicates a brief peace interval (Sep 1988-Jul 1990). The yellow section (8) illustrates the start of the first Gulf War (Aug 1990-Feb 1991).

Figure 4. Estimates of the probability of dying between age 15 and age 60, in Iraq 1979-1994, from sibling report in the University Collaborative Iraq Mortality Study National estimate of mortality deaths in Iraq 1979-1994.



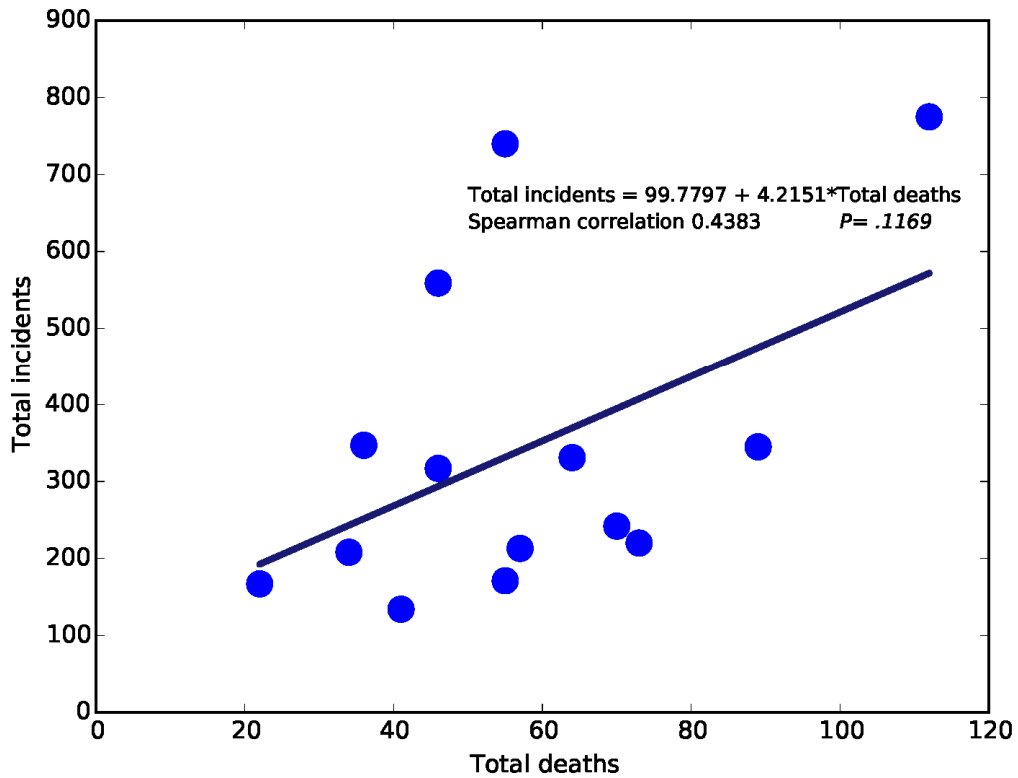
Source of data: Survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study. The vertical shading illustrates historical periods: (1) Iraqi invasion (Sep 1980-Jun 1982), (2) Iraqi retreat and Iranian offensive (Jul 1982-1983), (3) "Tanker war," (1984) (4) border skirmishes (1985-1986), (5) toward ceasefire (1987), and (6) the intensive bombing and other assaults on cities (Jan-Aug 1988). Period (7) indicates a brief peace interval (Sep 1988-Jul 1990). The yellow section (8) illustrates the start of the first Gulf War (Aug 1990-Feb 1991).

Figure 5. Number of *New York Times* news stories by year, 1980-1993, about Iraq and/or Iran.



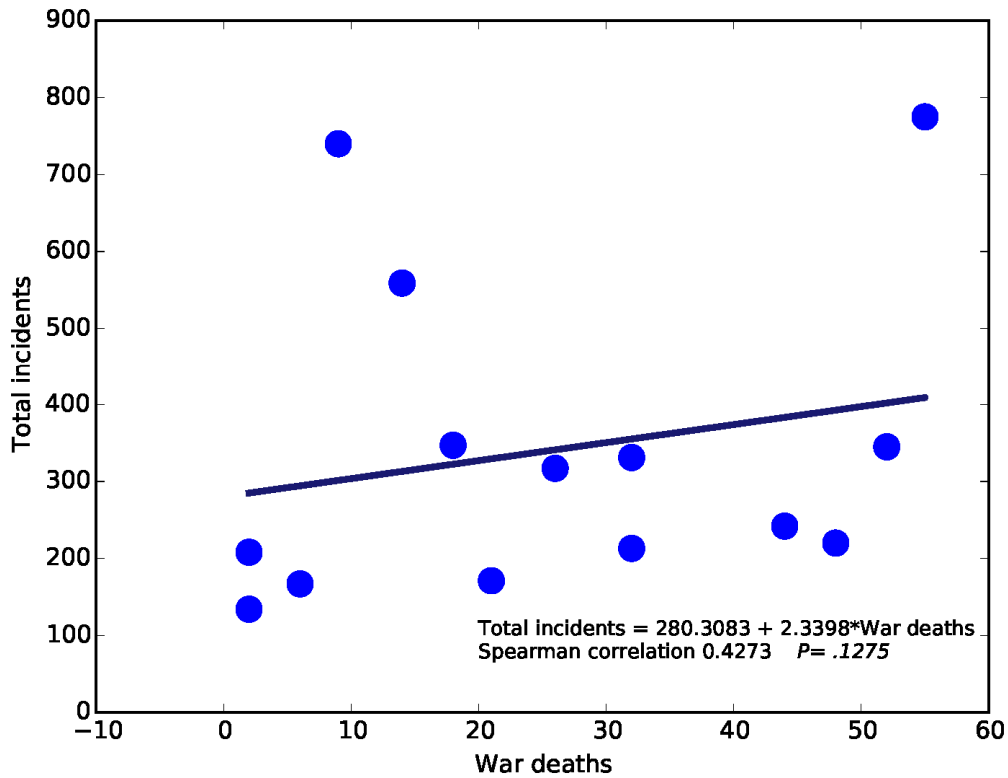
Source of data: Our review of ProQuest Historical Newspapers database for NY Times articles about Iran or Iraq for the period 1980-1993. Of 31,357 articles produced, this analysis displays results for 4,769 non-duplicate events by type.

Figure 6. Correlation between total death and total event incidence.



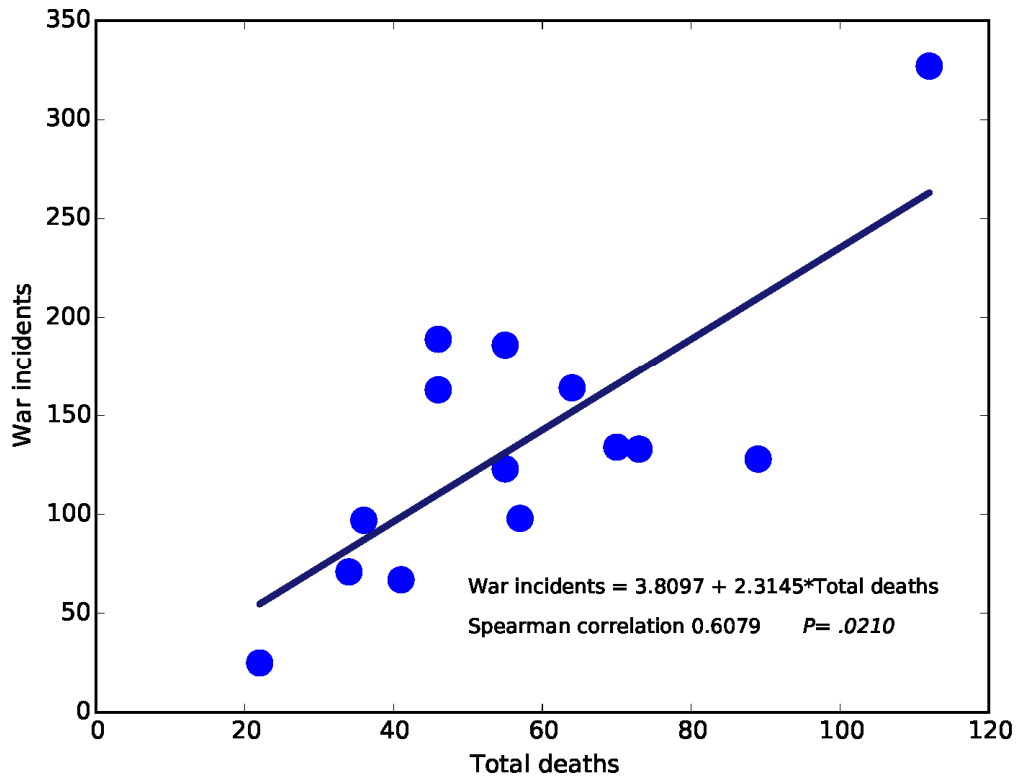
Source of data: Deaths come from a survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study. Total incidents come from our review of ProQuest Historical Newspapers data base for NY Times articles about Iran or Iraq for the period 1980-1993, illustrating 4,769 non-duplicate events. Spearman correlation between total events and total deaths is 0.43, *P-value* 0.11.

Figure 7. Correlation between war death and total event incidence.



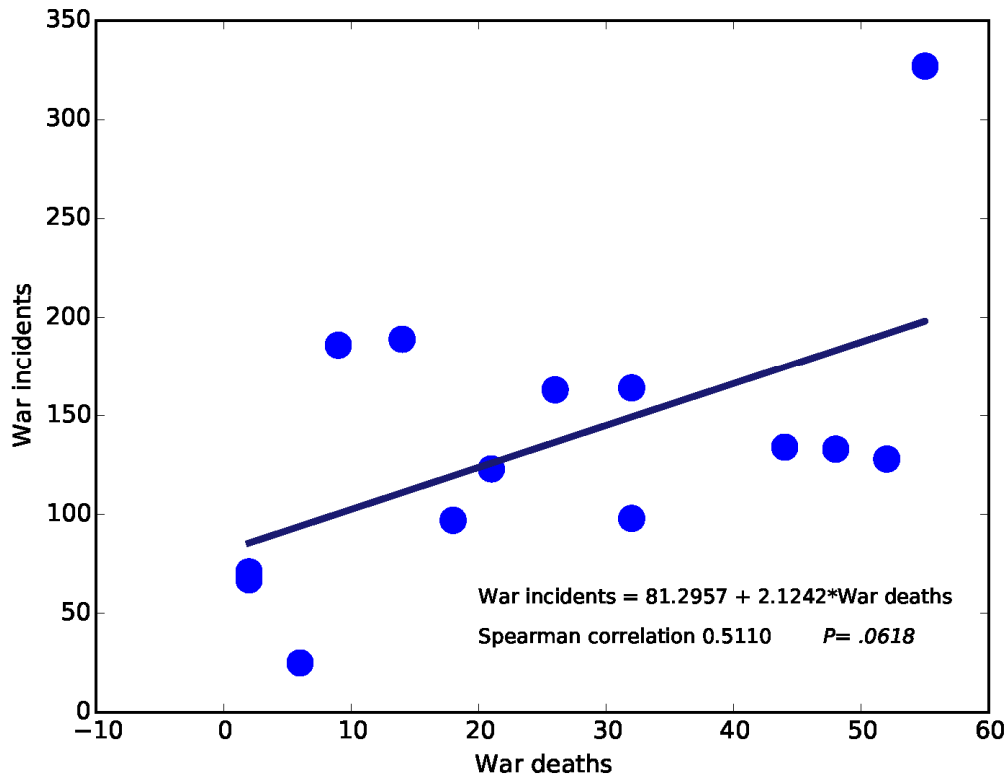
Source of data: Deaths come from a survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study. Total incidents come from our review of ProQuest Historical Newspapers data base for NY Times articles about Iran or Iraq for the period 1980-1993, illustrating 4,769 non-duplicate events. Spearman correlation between total events and total deaths is 0.42, *P-value* 0.12.

Figure 8. Correlation between total death and war event incidence.



Source of data: Deaths come from a survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study. Total incidents come from our review of ProQuest Historical Newspapers data base for NY Times articles about Iran or Iraq for the period 1980-1993, illustrating 4,769 non-duplicate events. Spearman correlation between total events and total deaths is 0.60, *P-value* 0.02.

Figure 9. Correlation between war death and war event incidence.



Source of data: Deaths come from a survey of 4,287 adults in 1,960 households in Iraq between May and July of 2011, with deaths recorded by cause for 2,531 siblings of the adults interviewed. Data provided by University Collaborative Iraq Mortality Study. Total incidents come from our review of ProQuest Historical Newspapers data base for NY Times articles about Iran or Iraq for the period 1980-1993, illustrating 4,769 non-duplicate events. Spearman correlation between total events and total deaths is 0.51, *P-value* 0.06

