



A Case Study in Estimating Casualties from War and Its Aftermath: the 1991 Persian Gulf War

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Deaths from war and postwar aftermath can be evaluated by breaking the problem down into two primary categories: expected versus excess deaths. The latter category consists of five subcategories: deaths from direct war effects to 1) the military and 2) civilians, deaths from postwar violence to 3) the military and 4) civilians, and 5) postwar deaths from health effects caused by destruction to a country's infrastructure. This paper demonstrates the methods used to estimate the number and age and sex distribution of fatalities for each of the categories by using available data on the Iraqi population and from the 1991 Persian Gulf war. [PSRQ 1993;3:57-66]

Methods used in epidemiology and demography can serve to estimate deaths from wars. Here these methods are employed to estimate the number of Iraqis who died in 1991 from direct or indirect effects of the Gulf war or from postwar violence.

The most recent data sources on Iraq and the procedure to estimate expected deaths are detailed. Five categories of "excess" deaths are created. Methods are

presented that estimate the number, age, and sex distribution of deaths in each category.

DATA SOURCES

Iraq's most recent census was conducted in October 1987. The census results used were those reported by Iraq in *The Annual Abstract of Statistics, 1988* [1]. The Iraqi government did not make available population distributions by ethnicity or religion.

In the 1980s, each of the seven countries in the Gulf region was surveyed by the Gulf Council of Health Ministers to evaluate the health conditions of children. The Iraqi sample included 9,404 households, 9,583 ever-married women of childbearing age, and 11,791 children under six years of age. Because Iraq was the last country surveyed, experts (demographers at UNICEF, personal communication) believe

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The views and estimates presented should in no way be construed as those of the U.S. Census Bureau.

that of the seven child health surveys, the National Child Health Survey (NCHS) conducted in Iraq in 1989 [2] is the best.

In 1990, UNICEF conducted the Iraq Immunization, Maternal and Childhood Mortality Survey [3], which estimated the extent of disease, vaccination, and mortality among mothers and children. Approximately 10,000 women in childbearing ages across Iraq were surveyed. The 1990 survey corroborated the results of the 1989 survey. The infant mortality rates (IMRs)¹ from both surveys for the late 1980s were in the low 40s [3] when analyzed by using indirect estimation techniques. Because the two surveys yielded similar infant and child mortality rates and neither survey's methodology seemed flawed, the results of both surveys can be treated with some confidence.

In August 1991, the International Study Team (IST), also known as the Harvard Study Team, conducted a community-based survey to assess the health conditions of children [4]. The ad hoc team consisted of approximately 50 volunteer researchers, including Dr. Timothy Coté, an epidemiologist, and had funding from the MacArthur Foundation and UNICEF. The survey was conducted between August 25 and September 5, 1991, and was intended to assess retrospectively child mortality in Iraq. A cluster sampling scheme was used and was based on detailed results of the 1987 census available in Iraq. Women across Iraq between the ages of 15 and 49 who had a live birth since 1985 were included in the sample, and approximately 16,000 live births were included in the mortality analysis done by the IST.

There is reason to believe that the IST underestimated infant mortality in Iraq, especially for the 1985-1990 period. The IST used a baseline infant mortality rate (IMR) of 32.5 to represent the 1985-1990 period in Iraq. This level is considerably lower than the estimates from other national surveys, which were in the low 40s. One reason why the IST's IMR might have been so low is that the researchers excluded cases with missing information. The IST's exclusion criteria excluded disproportionately more deaths than living children (96 cases were excluded, 35 of which were of children who at the time of the survey had died), which would have downwardly biased the IST's IMR both before and after the war. Although the exclusion

criteria omitted only 0.6% of all births, it eliminated from the analysis 4.4% of all deaths.

Another important data source is *Needless Deaths in the Gulf War* by Middle East Watch [5]. Here, numerous eyewitness accounts of civilians killed by direct war effects, such as bombing and strafing, are documented. This data source was used in conjunction with data on wartime civilian deaths obtained by a member of the IST from the Iraq Ministry of Defense.

Finally, William Arkin, a military analyst who was a member of the IST, has extensively analyzed military actions during the war. By recreating battles, he has created a data base of military deaths during wartime.

The U.S. military has published no estimates of the number of Iraqi civilian casualties in the Gulf war.

ESTIMATING EXPECTED DEATHS

It is necessary first to estimate expected deaths in order to estimate deaths from postwar health effects. People die in any population, even without war. The number of expected deaths in a year for any population can be calculated by multiplying the population by the probability of dying during the year for each age-group under normal circumstances.

However, before estimating the number of expected deaths in 1991, the population exposed to the probability of death under normal circumstances first had to be determined. To do this, the population from the 1987 census was smoothed, adjusted to account for underenumeration, moved to midyear, and then projected to 1991. Many steps were involved.

First, because the raw census figures include persons of unknown age (206,789 of the 16,335,199 persons enumerated [6]), these people needed to be given an age-sex distribution (the spreadsheet ADJAGE was used, Population Analysis Spreadsheet, Center for International Research, U.S. Bureau of the Census, Washington, D.C.). They were given the distribution of persons of known age and then added to the appropriate age-sex category. The population with the unknowns distributed will be referred to as the unadjusted population. The fluctuations between five-year age groups of the age and sex ratios of the unadjusted population showed that smoothing the population should be considered.

To see if real fluctuations existed between some cohorts that should not be smoothed, the birth cohorts of the unadjusted populations from the 1977 [7] and 1987 censuses were compared (Population Analysis Spreadsheets: GRPOP-YB, Center for International Research, U.S. Bureau of the Census,

¹ To calculate the IMR, the number of deaths to infants (children under one year of age) is divided by the total number of live births in the time period. Then, this number is multiplied by 1,000. Therefore, an IMR of, for example, 61 means that for every 1,000 live births in a given year, there were 61 infant deaths.

Washington, D.C.) This comparison showed that the cohort born between 1932 and 1937 (particularly tumultuous years in Iraq) in both censuses was particularly small. Further, the cohort born in the years 1957 through 1962 also seemed small, but this may just have been an echo effect of the 1932-1937 cohort (small because the cohort in which their mothers were born was small).

The age and sex ratios of the 1987 unadjusted census population were calculated, and both seemed irregular, i.e., they deviated greatly from 1². In particular, over the life cycle, the age ratios of males showed greater fluctuations than those of females. This greater fluctuation is uncommon because the age reporting of females is usually less reliable than that of males. A light smoothing (by using the Arriaga technique³) of the population was attempted, but this method smoothed out the 1932-1937 and 1957-1962 birth cohorts and therefore was not done.

Because the age ratios and the graphs of the age and sex distribution of the population showed that the age structure of the female population seemed more reliable than that of the male population, the male population was smoothed by using a moving average of the sex ratios. That is, the female population was accepted and the male population between the ages of 10 and 74 was a function of a moving average of the sex ratio of the unadjusted population. The male population was then adjusted back to the original total. This procedure yielded a population with somewhat smoother age and sex ratios.

Often, censuses underenumerate children. To see if that was the case in Iraq, a technique that applies fertility rates to women was used (Arriaga technique). This procedure showed only underenumeration among infants (persons younger than one year of age). From the Arriaga technique, only the number of infants by age and sex were adjusted. Children ages one through four and five through nine in the base population were unadjusted.

The last step in preparing the base population for the projection was to move the adjusted 1987 census population from the census date (October 17) to midyear. This was done by using software provided by the U.S. Census Bureau (MOVEPOP, PAS Series,

U.S. Census Bureau, Washington, D.C.). After the 1987 midyear population was prepared, it was projected to 1991 by using the component method. To do this projection, levels and patterns of fertility and mortality first had to be projected through 1991. To arrive at the number of expected deaths in 1991, the mortality patterns and levels under normal circumstances were applied to the 1991 projected population. What follows is a description of the components of the projection.

Fertility

The fertility rates used in the projection determine the number of children born in the time period. The total fertility rate (TFR) is the number of children a woman would bear if exposed to a given period's age-specific fertility rates throughout her lifetime. This rate varies from country to country. By projecting the TFR, estimating the age structure of childbearing, and applying these birth probabilities to the female population between 15 and 49 years of age, one can estimate the number of children born during each year of the period.

The TFR reported varied between data sources. To project the TFR, it is necessary to have at least two reliable estimates from different times in a nation's recent history. With two estimates and the assumption that if fertility is decreasing it is doing so logistically, it is possible to estimate a country's present TFR [8]. The two estimates used were an estimate of 7.4 for 1974 [9] (based on a survey in that year) and an estimate of 6.1 for 1988 (based on the analysis done by the United Nations Economic and Social Commission for Western Asia) [10]. Demographers who study Iraq accept these two estimates as reflecting actual fertility in Iraq reasonably well. Other fertility estimates were considered, but not utilized in this projection because they seemed implausible in light of the social change in Iraq since 1974. A discussion of other fertility estimates that were considered but not utilized is included in the technical documentation available from the author upon request.

Mortality

The age-specific mortality rates (ASMRs) used in the projection will determine the number of expected deaths between 1987 and 1991. A typical mortality pattern has mortality at its highest during the first year of life, at its lowest in the teens, and then increasing thereafter with age. A lack of ASMRs at all ages in Iraq necessitated the use of model life tables; the tables allow one with minimal mortality data on a

² An age ratio indicates the size of a birth cohort in comparison with birth cohorts both younger and older than it.

³ For details on this technique, see "The Analysis by Computer of Demography" by Eduardo Arriaga and Associates, Center for International Research, U.S. Bureau of the Census, December 1990, Chapter 8, Appendix VIII-3, Sections 1 and 2 (pp III-39 through III-54).

population to obtain mortality rates for all ages in a population. In the Iraqi population, because the surveys in 1989 and 1990 focused on children, the most accurate ASMRs available are for infants (<1 year of age) and for children between the ages of one and four years of age.

Therefore, mortality was projected by fitting infant mortality rates for each sex to a logistic curve and then obtaining the life table that corresponded to the projected IMR. This method assumes that the infant mortality rate was and will continue to decline in a logistic fashion and that the schedule of mortality for other ages in the life cycle in Iraq is accurately reflected by the mortality schedules of the model life tables. The IMRs noted by Dr. Gareth Jones, an epidemiologist for UNICEF, (unpublished data, 1992) were used as input for the projection, which yielded a 1991 IMR of 37. The child mortality rates from the surveys were compared with those from the model life tables (selected by the observed IMRs), and the child (one through four years) mortality rates from the two sources concurred.

Dr. Jones's unpublished report analyzed the decline in infant and child mortality in Iraq since the 1960s by synthesizing available mortality information. He found that infant and child mortality had decreased rapidly in Iraq, which may surprise some. Dr. Jones notes, however, that throughout the 1980s, infant mortality decreased rapidly in Iraq, perhaps because in 1980, Iraq embarked on a campaign to reduce its infant mortality by half by 1990. In 1977, Iraq's IMR was at 61; by 1987, it had dropped to between 36 [2] and 42 [3]. The report on the 1990 survey [3] also discussed the rapid drop in infant mortality in the 1980s. The report notes that "Evidence from this survey as well as the findings of the Iraq NCHS of 1989 point to a strong rapid downward trend in infant and child mortality over the past fifteen years. During the 1980s, in particular, the downward trend in infant mortality has been particularly steep" [3].

Because the 1989 and 1990 surveys showed that mortality had decreased rapidly in Iraq in the 1980s, former work on infant mortality in Iraq by the United Nations [10] and the U.S. Census Bureau (unpublished data, March 1991 WP92 Iraq file folder) that did not consider these surveys overestimated the extent of prewar infant mortality in Iraq. When one compares the United Nations' IMR of 62.5 from their 1988 data sheets with those from the surveys, one sees that the U.N.'s IMR is substantially greater. The life tables the author obtained based on the projection of

the infant mortality rates were compared with the life tables reported by the United Nations in 1988. One finds that the life tables are alike, except for the groups less than one year and one through four years of age. The life tables substantially differ only at these young ages. A possible explanation for this difference is that although the U.N. in 1988 based the mortality rates for Iraqi adults on death registration data, adjusted for underregistration, its infant mortality rates were based on the children ever born/children surviving data collected in 1974 and 1980 fertility surveys and the 1987 census. The U.N. then used exponential regression to obtain IMRs. For children one through four, the completeness of child death registration system was assumed to be the same as that for infants [10]. The U.N. methods used to estimate infant and child mortality in Iraq did not consider evidence from the 1988 and 1989 surveys. That the adult mortality rates from the U.N. and the technique used by the author corresponded well lends more certainty to the lower prewar infant mortality rates derived from the 1989 and 1990 surveys.

Migration

The migration patterns in Iraq between 1987 and 1991 are also key if an accurate projection of the population is to be made. Because migration data for any population is usually the least accurate, this component is often the most difficult to estimate.

It is clear that many foreign guest workers and their families fled Iraq after Iraq invaded Kuwait [11]. However, it is not clear how many persons left. Whether this is important or not to this research depends on whether these foreigners were included in the 1987 census. Iraqi diplomats insist that their 1987 census did not include non-Iraqis, while demographers who work on Iraq seem to be split on this issue. In other words, it is uncertain whether or not foreigners were included in the 1987 census.

In order to determine if these foreigners were included, a few calculations are necessary. First, Iraq's 1987 census [1] yielded unacceptably high sex ratios (the ratio of males to females in the population) for the ages between 10 and 54 years (sex ratios of the five-year age groups increased and were approximately 111 for the age groups 20 to 24 and 25 to 29, and then declined slowly after that). Approximately 400,000 men in these age groups would have to be removed to make these ratios smoother and closer to unity for these age groups. These 400,000 men were suspected to have been migrants living in Iraq.

Considering that at least 105,000 men died during the entire Iran-Iraq War [12] and the sex ratios at the military ages would be further deflated from these deaths, then one would suspect that even more than 400,000 male migrants were included in the census results. Therefore, we can assume that a certain number of foreign workers (who were mostly males) were counted in the 1987 census, especially since the life expectancy for Iraqi females exceeds the life expectancy for Iraqi males by approximately two years (unpublished personal data). Since Iraq did not have emigration of women, there is no other way to account for the excess males in the population.

The International Labour Organization (ILO) reported that approximately 1.2 million economically active non-Iraqis resided in Iraq in August of 1990 [11]. Experts believe that after the end of the Iran-Iraq War (1988), a concerted effort was made by the Iraqi government to encourage foreign workers to leave. This information implies that there were more than 1.2 million non-Iraqis in Iraq in 1988. It seems likely that although the 1987 data included some non-Iraqis present in Iraq then, the data did not include all non-Iraqis.

Although it is clear that a great number of foreign workers fled Iraq after the invasion of Kuwait, no reliable estimate of the number exists. Archer and Iscoll of the U.S. State Department noted in 1991 [13] that more persons were reported as returning to a country from Iraq than the ILO had reported were in Iraq in August 1990. For example, Archer and Iscoll report 150,000 foreign workers and dependents fleeing to India, while the ILO reported only 9,000 persons from India in Iraq in August 1990. In their article, they did not indicate the source of their statistics.

Because it is unknown how many non-Iraqis were included in the census population (although it seems some were included) and how many were in Iraq in 1991, net migration was not included in the projection. By not subtracting foreign migrants who fled, the Iraqi 1991 population may be slightly inflated; however, this decision does not compromise the estimate of excess deaths because the affected age groups have relatively low age-specific mortality rates.

The Projection of the 1987 Midyear Population

After obtaining the fertility and mortality rates for the 1987-1992 period and deciding on how to treat net migration, the 1987 midyear population was projected (Rural-Urban Projection Program was used, Peter Johnson, U.S. Census Bureau, Washington, D.C.). The projected population for Iraq in 1991 was estimated at

18.4 million.

There are two weaknesses in this projection. First, the projection does not account for the excess deaths of Iraqi males from the Iran-Iraq war between 1987 (the census date) and August 1988 (the end of the war). These men were not removed from the population statistics because no reliable estimate for the number of deaths exists for the last nine months of the Iran-Iraq War. (The number may not be large because the rate of killing seems to have slowed by this period in the war: 105,000 Iraqi soldiers were believed to have died in the entire war [12].) Second, the number of foreign workers who left in 1990 was not removed because of great uncertainties surrounding the migration figures. Both of these factors slightly inflate the Iraqi population for 1991.

Expected Deaths

After performing all the calculations above, the number of expected deaths in Iraq under normal circumstances can be estimated for 1991. The total number of deaths would have been approximately 110,000. Of these, 35,000 (32%) would have been children (under 15 years old), 39,000 (35%) would have been men (males 15 or older), and 36,000 (33%) would have been women (females 15 or older). Life expectancy in Iraq would have been 67.8 years, and the infant mortality rate would have been 37.1 (Table).

ESTIMATING IRAQI CASUALTIES FROM THE 1991 PERSIAN GULF WAR

By definition, the number of excess deaths in a population is the number who die beyond the number of

Table. Infant Mortality and Life Expectancy in Iraq by Sex Assuming No War, 1974-1992

Year	Infant Mortality Rate			Expectation of Life at Birth	
	Both	Male	Female	Male	Female
1977	70.4	71.4	69.4	59.6	60.5
1987 ¹	45.4	46.0	44.7	65.2	66.5
1988 ¹	43.2	43.8	42.6	65.6	67.1
1989	41.1	41.7	40.5	66.1	67.6
1990	39.0	39.6	38.5	66.5	68.2
1991 ¹	37.1	37.6	36.5	67.0	68.7
1992 ²	35.2	35.7	34.7	67.5	69.2

¹ These mortality levels do not incorporate deaths from wars.

² Projected under the assumption of neither war nor postwar violence. Source: Daponte, July, 1992, unpublished worktables.

expected deaths. There are five categories for excess deaths in Iraq in this report: 1) civilian deaths from war-induced adverse health effects, 2) deaths to Iraqi military during the war, 3) civilian deaths caused by violence during the war, 4) civilian deaths from postwar violence, and 5) military deaths from postwar violence. Each of these categories of deaths is estimated separately.

Civilian Deaths from War-Induced Adverse Health Effects

Deaths from war-induced adverse health effects include those caused indirectly from the collapse of the infrastructure, including disruption in electrical services, transportation systems, and distribution networks. Such deaths may be due to gastrointestinal and respiratory infections and other diseases and infections that thrive on weakened populations. In order to estimate excess deaths from adverse health effects, expected deaths (assuming no war) must be subtracted from the number of persons who have died under the higher mortality probabilities prevalent in Iraq during the postwar period. Data from the community based survey of the IST [4] show that mortality rates for infants and children rose substantially after the war. In the IST's survey conducted in August 1991,

they found that the IMR had risen to 93; this number would have been approximately 37 without the war.

To estimate child mortality after the war, the IST surveyed mothers and their children in Iraq. Their work was invaluable but slightly exaggerated because of the criteria they used to clean the data. The IST excluded cases with missing information, which, in turn, deflated their prewar IMR estimates since some of these cases were undoubtedly legitimate. For the period before the war, from 1985 to 1990, they estimated an IMR of 32.5, which must be seen as too low and disregarded. However, the estimate of IMR after the war would also be conservative for the same reasons, and it is the best one available. Because of this, the IST's postwar IMR estimate of 93 was used.

The postwar infant and child mortality rates were used in conjunction with model life tables to obtain mortality probabilities at all ages in the life cycle (Fig 1). The population alive in 1991 who did not die of direct war effects or postwar violence was multiplied by these high postwar mortality probabilities. Subtracting the expected deaths from this inflated number of deaths after the war, one finds that approximately 111,000 persons died in 1991 from health effects of the Gulf war. Approximately 70,000 of these deaths were to children (persons under 15

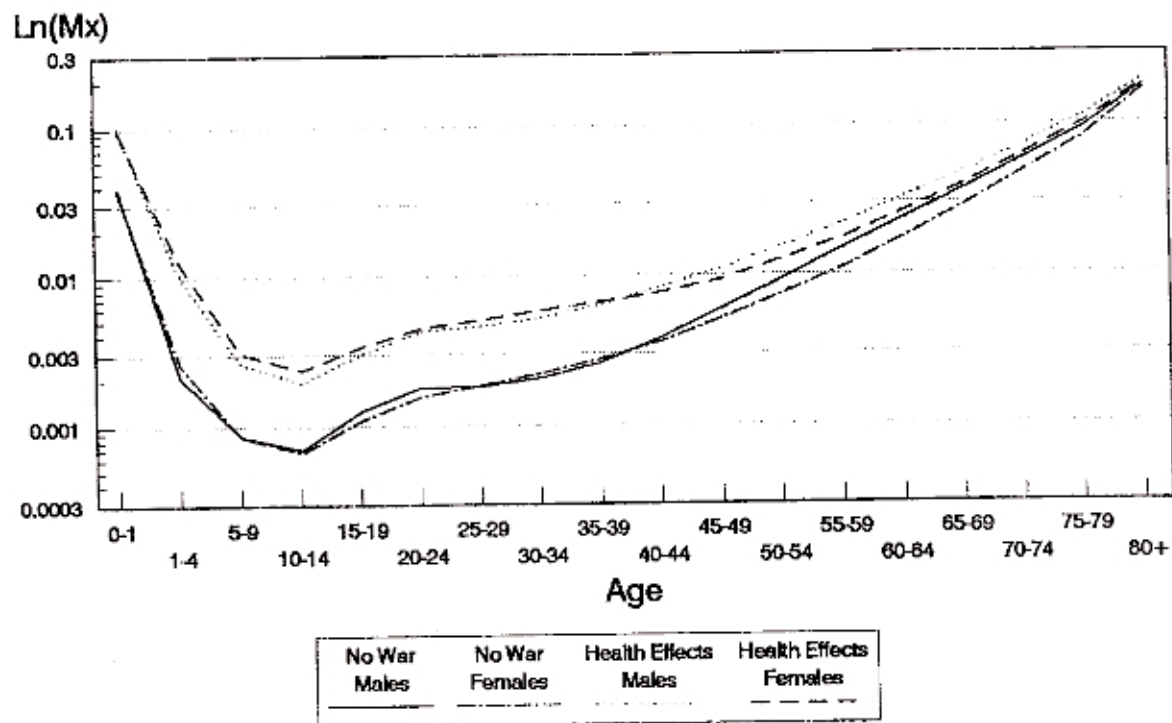


FIGURE 1. Age-specific mortality rates with and without postwar health effects. $\ln(M_x)$ = natural logarithm of the age specific mortality rate.

years of age) and 8,500 to the elderly (persons over 65 years of age).

One should be aware that these mortality rates did not prevail during the entire year and that the conditions to which the population was exposed quickly improved. The mortality rates prevalent in August 1991 did not take into account the conditions that were much worse immediately following the war. Because of this, the IMR of the IST's survey underestimated mortality in the first half of 1991, but overestimated it for the second half of 1991. We assume that these considerations balance out. Another criticism may be that the schedule of age-specific mortality rates from a model life table may not apply to a postwar population, i.e., age and sex patterns of mortality prevalent in populations under ordinary circumstances may not prevail in postwar populations. Research on postwar populations is needed to better understand mortality schedules that prevail after conflicts.

Wartime Military Deaths

William Arkin, a military analyst for the IST, has extensively studied the military aspects of the Gulf war. He has estimated that between 49,000 and 63,000 soldiers died during the war (personal written communication, July 1992). Much of the uncertainty in the estimate comes from uncertainty in the number of Iraqi soldiers actually involved in the conflict. According to Arkin, 20,000 to 25,000 men died from air attacks in Kuwait, 12,000 to 15,000 died from air attacks in Iraq, and 17,000 to 23,000 died during the final ground war. Arkin's midpoint estimate of 56,000 military deaths during the war was accepted under the assumption that they had the same age and sex (all male) distribution as the Iraqi military before the war.

Wartime Civilian Deaths

To estimate the number of civilian deaths from direct war effects, a data base to include every documented death was constructed. A number of sources cite incidents of deaths to civilians. Each incident in the data base includes a date, place, brief description, and the number of civilians killed and injured. Most of this was compiled through "eyewitness" reports from people who actually observed the event⁴.

⁴ Four sources were used to create the data base: internal documents from Greenpeace International, which include information collected by William Arkin while he was in Iraq in August 1991; *Needless Deaths in the Gulf War* by Middle East Watch, New York: Human Rights Watch, 1991; a July 17, 1991, internal memorandum from Middle East Watch; and *War Crimes: A Report on United States War Crimes against Iraq* by Ramsey Clark and others, Washington, D.C.: Maisonneuve Press, 1992. Further details on this data base are available on request from the author.

Middle East Watch relied heavily on these reports, which may not be comprehensive but are the best information available for the time of conflict. Of course, incidents may have occurred that were not reported. A further difficulty in relying on such reports is that frequently what seems like the same incident (based on the location, description, and date) is reported more than once, even within the same source. In these instances, the incident was included in the data base only once.

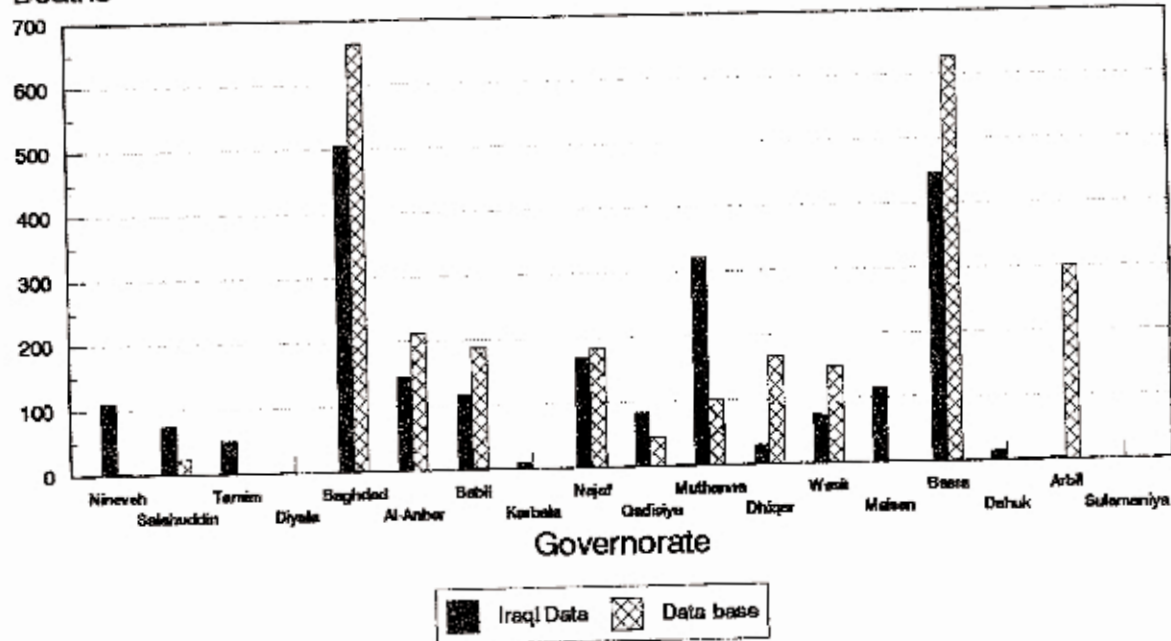
In addition to the eyewitness reports, the Iraqi Ministry of Civil Defense released information in August 1990 of the number of deaths, injuries, and houses destroyed in each governorate. This information was compared to the data base. The comparison between these two sources suggests that the Iraqi government did not systematically over- or underestimate the number killed (Fig 2).

The constructed data base recorded 2,665 civilian deaths. According to the Iraqi government, 2,278 civilians died. We must assume that at the governorate level neither of these estimates is comprehensive. Another assumption is that if a death was reported in either source, then it occurred. That is, if either an eyewitness or the Iraqi government reported a death, then the death occurred. Either source could underreport deaths. This implies that if there were two different figures for the number of deaths in a governorate, then one ought to use the higher figure of the two. With this method, the difference in any single governorate between the two data sources ranged from 2 to 297 deaths. With these assumptions, the total number of civilian wartime deaths was 3,664. Because there may be some overreporting of deaths and uncertainty in the absolute number, it is concluded reasonable to settle on the estimate of 3,500 civilian deaths from direct war effects⁵.

In order to estimate the age and sex distribution for the civilians killed, data from the Iraqi Ministry of Civil Defense (unpublished data) were used. The data had deaths by broad age group and sex. The distribution of deaths was compared to the distribution of the 1991 projected population (Figs 3 and 4). Males accounted for 62% of the deaths, but only 51% of the projected population. One possible reason for more male deaths is that women may have been moved to safer locations.

⁵ Other estimates of civilian deaths include the US Census Bureau estimate of 5,000 deaths, see "Population Estimates for Iraq" (research note) by Frank Hobbs, Washington, D.C.: Center for International Research, US Bureau of the Census, January, 1992.

Deaths



Sources: Deponte, 1992, unpublished database;
Iraq Ministry of CMI Defense, 1991.

FIGURE 2. Comparison of excess deaths of Iraqi civilians during wartime by governorate and source.

Deaths

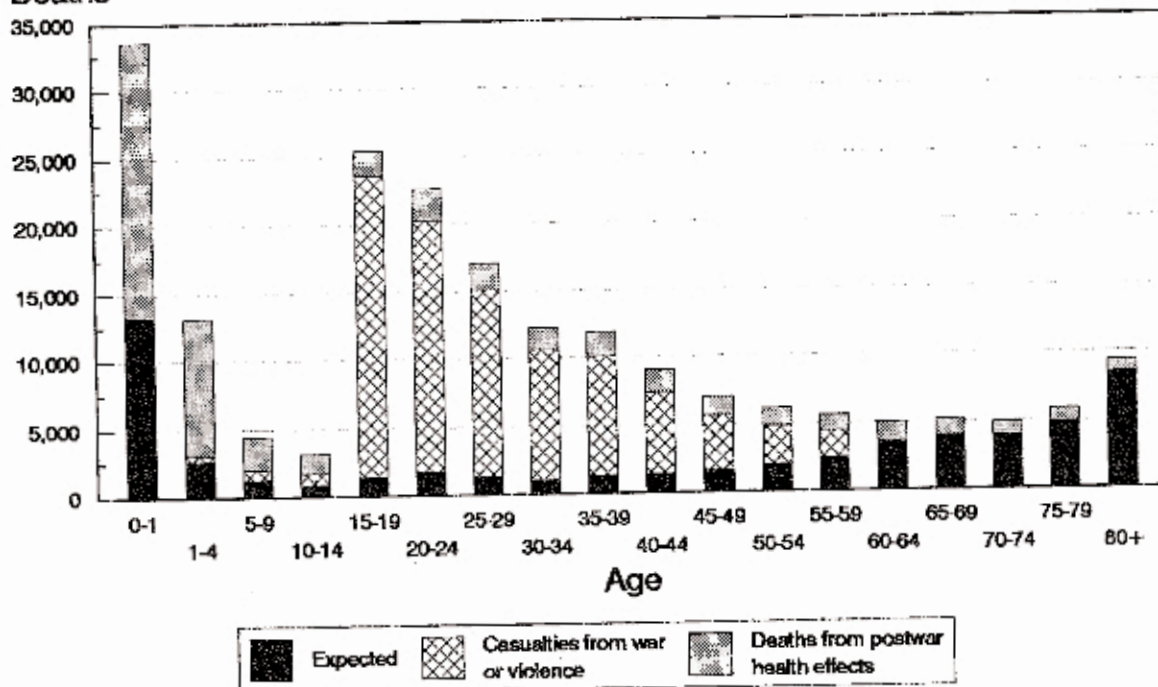


FIGURE 3. Expected and excess deaths of Iraqi males by age and type of death, 1991

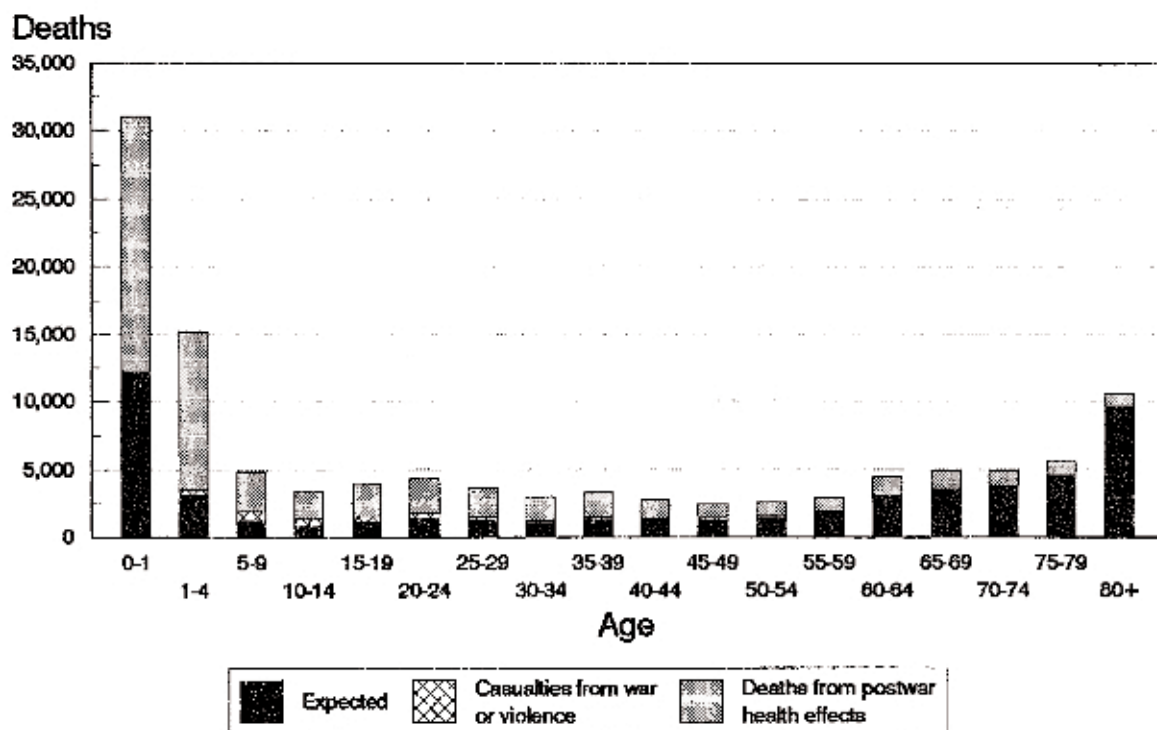


FIGURE 4. Expected and excess deaths of Iraqi females by age and type of death, 1991.

Further, regarding the age distribution of deaths, persons 15 through 44 years and 45 through 64 years were overrepresented. Perhaps the most vulnerable were moved to locations that were less susceptible to bombing, or perhaps adults 15 through 64 were located in more precarious places (such as work) at a particular time

Civilian and Military Postwar Deaths from Violence

Beginning on March 1, 1991, the day after the ceasefire, uprisings began to sweep through Iraq [14]. The violence was primarily in the Kurdish north and Shiite south during March and April 1991. An untold number of people died, and the estimate in this report of excess deaths during this time is the most uncertain. In *Endless Torment*, Middle East Watch describes a scene of mass chaos in northern and southern Iraq. Although the number killed in the postwar turmoil is impossible to estimate, two independent sources (William Arkin and the U.S. Census Bureau) arrived at the same estimate: 30,000 civilian deaths and 5,000 military deaths. The U.S. State Department, in a separate document, reported that the suppression of the uprisings accounted for "casualties estimated in the tens of thousands" [15]. No additional information on the number of postwar civilian deaths seems to exist at this time.

The military deaths were assumed to be to males and distributed according to the age distribution of the Iraqi military (unpublished data, March 1991 WP92 Iraq file folder). Three-quarters of the deaths to civilians were assumed to be to civilian combatants, including military deserters, and these deaths were distributed according to the age-sex distribution of military personnel. The remaining 25% of civilian deaths were assumed to have the age-sex distribution of civilians who died from direct war effects.

CONCLUSIONS

According to the methods described in this paper, the number of Iraqis who died in 1991 from effects of the Gulf war or postwar turmoil approximates 205,500. There were relatively few deaths (approximately 56,000 to military personnel and 3,500 to civilians) from direct war effects. Postwar violence accounted for approximately 35,000 deaths. The largest component of deaths in this reconstruction derives from the 111,000 attributable to postwar adverse health effects. Of the total excess deaths in the Iraqi population, approximately 109,000 were to men, 23,000 to women, 74,000 to children⁶.

⁶ These figures do not add up to 205,500 because of rounding error.

The substantive result of this research is that in modern warfare, postwar deaths from adverse health effects account for a large fraction of total deaths from war. In the Gulf war, far more persons died from postwar health effects than from direct war effects. Although the quality of demographic data from wars may be poor, this result is likely to hold even when one considers possible errors and uncertainty in the data. Certainly, one could repeat this analysis with somewhat different assumptions and obtain somewhat different numbers. However, to call into question the substantive result of this work, one would have either to increase wartime deaths by a great amount or greatly decrease postwar deaths from health effects.

Let us consider doing this. The Defense Intelligence Agency (DIA) released (the only U.S. military agency to do so) the highest estimate of Iraqi military wartime deaths: 100,000, plus or minus 50,000 [16]. Although the DIA's figures are unverifiable, if one uses the 100,000 figure, one finds that postwar deaths from adverse health effects would still account for the largest component of deaths due to war. Further, because the work presented here estimates that civilian wartime deaths composed less than 2% of all deaths due to the war, one would need to alter drastically the figure on civilian wartime deaths to change the substantive result. Alternatively, one could decrease the number of deaths from postwar health effects. To do this, one would need to decrease the population that was exposed to the difference in mortality rates, greatly increase the prewar mortality rates, and/or greatly decrease the postwar mortality rates. It would be difficult to justify changes large enough that would so greatly affect the results. For example, the U.S. Census Bureau arrived at 70,000 excess deaths from adverse health effects, by using a somewhat different 1991 population, a 1990 IMR of 67, and a postwar IMR of 81 [17].

The effects of war continue long past the time of conflict. The lethality of indirect effects of warfare can be much greater than the direct lethality of the weapons themselves. ■

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