Injury Burden During an Insurgency: The Untold Trauma of Infrastructure Breakdown in Baghdad, Iraq

Ross I. Donaldson, MD, MPH, CTropMed, Yuen Wai Hung, BS, Patrick Shanovich, MD, Tariq Hasoon, PhD, and Gerald Evans, PhD

Background: Injuries as a result of the ongoing violence in Iraq have been a topic of both lay and academic interest. However, to date, attempts to quantify injuries in the country have focused primarily on direct mortality, which represents only a small portion of overall injury burden and ignores those injuries indirectly resulting from the conflict-induced breakdown of Iraqi infrastructure.

Methods: We performed a cross-sectional household survey from October to November, 2009, within the Baghdad Governorate of central Iraq. Using two-stage cluster-sampling with a proportional-to-size methodology, we randomized a total of 60 clusters to Baghdad's five governmental districts. Within each cluster, we interviewed heads of households regarding all injuries during the last 3 months.

Results: We surveyed 1,172 households, gathering information regarding 7,396 individuals. Only 8.4% of injuries were intentional, and fatalities represented only a small fraction (1.7%) of overall injury burden. The well-publicized intentional explosions in Baghdad, although accounting for close to half (44%) of all intentional injuries, made up only 4% of the total. Other injuries at least partially attributable to the conflict-induced breakdown of Iraqi infrastructure proved a much larger burden, for example, those from electric shock, unintentional explosions, unintentional gunshot wounds, and falls.

Conclusions: Past and current fighting in Baghdad continues to adversely affect the Iraqi populace, where the indirect effects of infrastructure breakdown are likely the primary source of injury. When measuring the burden of large-scale violence, health researchers should account for the full injury burden, including both injury morbidity and indirect injuries.

Key Words: Conflict; Injury; Iraq; War.

(*J Trauma.* 2010;69: 1379–1385)

Submitted for publication April 15, 2010.
Accepted for publication August 9, 2010.

From the Department of Emergency Medicine (R.I.D., P.S.), Harbor-UCLA Medical Center, David Geffen School of Medicine at UCLA, Los Angeles, California; and International Medical Corps (R.I.D., Y.W.H., P.S., T.H., G.E.), Baghdad, Iraq.
Supported by Australian Agency for International Development (AusAID), Iraqi Ministry of Health, and International Medical Corps.

This work was supported by funding from the Australian Agency for International Development (AusAID), which played no direct role in the design or conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript. RID had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Author Contributions: PS, RID, and YWH designed the study. PS and YWH trained and supervised field staff. PS, RID, and YWH analyzed and interpreted data. GE, PS, RID, TH, and YWH prepared the manuscript. GE and RID obtained study funding.
Address for reprints: Ross I. Donaldson, MD, MPH, Department of Emergency Medicine, Harbor-UCLA Medical Center, 1000 West Carson Street, Box 21, Torrance, CA 90509; email: ross@rossdonaldson.com.

DOI: 10.1097/TA.0b013e318203190f

Injuries as a result of ongoing violence in Iraq have been a topic of both lay and academic interest. The Baghdad governorate, comprising around a quarter (~7.1 million people) of the country's population,[1] has been at the heart of many such reports. However, despite significant improvements in security over the past several years and the withdrawal of coalition forces from the city center, dramatic acts of group violence continue to threaten the populace on an almost daily basis.

Similar to other conflict-induced complex emergencies,[2–6] researchers have attempted to quantify the direct violence-related mortality within Iraq despite a breakdown of traditional surveillance mechanisms.[7–13] The most recent (mid-2006) study estimated that there were around 126 (95% confidence interval [CI], 84–200) violence-related deaths per day (1.5 deaths per 1,000 person-years), with the majority occurring within the civilian populace.[9]

Previous studies of wartime civilian injuries in other countries have demonstrated that fatalities represent merely the tip of the injury pyramid and that mortality data thus represents only a small fraction of injuries from large-scale violence.[14] Despite calls for a better understanding of the full injury burden in conflict areas, both for Iraq and elsewhere, we have a limited grasp of injury epidemiology in these locations because of inherent difficulties of performing such research.[14]

The dearth of reports from active conflict zones leaves public health planners deficient in two main areas. First, we have a poor understanding of injury morbidity in these arenas. Second, we have limited knowledge regarding the indirect injury burden, which we define as those incidents resulting from the breakdown of infrastructure and society (electricity, housing, etc.) associated with such fighting.

To provide this information, we performed a household cluster study of injury in the Baghdad governorate. The purpose of the study was to elucidate the full injury burden for the population, thus allowing better planning for prevention and treatment activities within Baghdad, as well as enabling a better understanding of injury epidemiology in an area of large-scale group violence.

MATERIALS AND METHODS

Study Design

We administered a cross-sectional household cluster survey from October to November, 2009, within the Baghdad

Governorate of central Iraq. The Human Subjects Committee at the Los Angeles Biomedical Research Institute, Los Angeles, and the Ministry of Health, Iraq, gave ethics approval for this study.

We developed the survey instrument by modifying World Health Organization community injury and violence survey guidelines[15] to the local context. The recall period was 3 months for all injuries and 1 year for injuries resulting in death. After initial development in English, local International Medical Corps (IMC) staff translated the survey into Arabic. Interviewers then tested the instrument in 60 households to assess problems with comprehension and application.

We defined injury as any type of physical harm that resulted in the loss of at least 1 day of normal activity or in the seeking of treatment at a health care facility. For study design, we assumed an injury incidence rate of 50 per 1,000 person-years, as estimated by the 2007 national Iraq Household Socio-Economic Survey.[16] Using this assumed injury incidence rate, a nonresponse rate of 10% and an average household size of six, we calculated needing to sample 1,045 households to obtain a 95% CI with 2% margin of error and a design effect of 3.0 to compensate for correlation within households and cluster sampling.

Survey Administration

We used a two-stage, cluster-sampling methodology to randomly select households in Baghdad, Iraq. At the first stage of sampling, using a population-proportional-to-size method, we determined the number of clusters in each of Baghdad's five districts, identifying a total of 60 clusters (each containing 20 households). We then randomly selected each neighborhood cluster within the districts using an established administrative numbering system for Baghdad.

Interviewers were Iraqi Ministry of Health staff with previous community health experience. Before data collection, they underwent a 3-day training session that included instruction in survey administration and on-site decision-making according to an established protocol. If the methodology selected one of a small handful of prespecified locations considered too insecure by the Ministry of Health, we selected a substitute cluster via the same sampling methodology.

For each cluster, interview teams made their best estimation of a neighborhood's geographic center and selected a household north of that location as the starting point. For this study, we defined a household as a unit that eats together and has a separate street or apartment entrance. From the start household, interviewing teams proceeded clockwise to adjacent residences until they surveyed a total of 20 households, skipping empty houses without occupants.

After briefly explaining the purpose of the survey, interview teams obtained verbal consent from participants. Interviewers administered the survey to the head of the household or another eligible adult, if the head of household was not available. If a household was occupied but an eligible adult was not available, interview teams returned later the same day. Teams conducted all interviews during the daytime to maximize security. Interviewers had the authority to select alternate households if they perceived an unacceptable level of insecurity or risk during survey administration.

To ensure the quality of data collection, team supervisors reinterviewed 4.5% of the households at random. For quality assurance, we subsequently compared these results to initial data.

Statistical Analysis

After removing identifiers, IMC staff entered the survey data into an Access (Version 2007) database. We then performed a descriptive statistical analysis of the full dataset using STATA (version 10.1; Stata Corporation, TX), assuming a Poisson distribution for injury incident rates. We additionally compared subgroups using Pearson Chi-Square test for categorical data and a regression analysis for risk factors analysis.

RESULTS

Population Demographics

We interviewed 1,172 households, gathering information regarding 7,396 individuals, with a household participation rate of 97.7% (see Table 1). The sample population

TABLE 1. Population Demographics

	Total, n (%)	Males, n (%)	Females, n (%)
Age			
0–5	828 (11.2)	437 (11.5)	389 (10.8)
6–15	1,432 (19.4)	745 (19.6)	687 (19.1)
16–25	1,635 (22.1)	855 (22.5)	780 (21.7)
26–45	2,230 (30.2)	1,139 (30.0)	1,088 (30.3)
46–59	783 (10.6)	384 (10.0)	399 (11.1)
≥60	488 (6.6)	240 (6.3)	248 (6.9)
Occupation			
Civil servant	920 (12.4)	616 (16.2)	304 (8.5)
Self-employed	1,012 (13.7)	994 (26.2)	18 (0.5)
Professional	105 (1.4)	61 (1.6)	44 (1.2)
Street vendor	26 (0.4)	19 (0.5)	7 (0.2)
Student	1,996 (27.0)	1,089 (28.7)	905 (25.2)
Homemaker	1,764 (23.9)	22 (0.6)	1,742 (48.5)
Farmer	5 (0.1)	0 (0)	5 (0.1)
Retired	279 (3.8)	224 (5.9)	55 (1.5)
Unemployed (able to work)	268 (3.7)	190 (5.0)	78 (2.2)
Unemployed (unable to work)	75 (1.0)	53 (1.4)	22 (0.6)
None (under work age)	854 (11.6)	452 (11.9)	402 (11.2)
Other/refused	86 (1.2)	77 (2.0)	9 (0.3)
Education			
None (under school age)	847 (11.5)	444 (11.7)	401 (11.2)
Illiterate	451 (6.1)	109 (2.9)	342 (9.5)
Elementary school	2,284 (30.9)	1,146 (30.2)	1,138 (31.7)
Secondary/high school	2,096 (28.3)	1,141 (30.0)	955 (26.6)
Vocational college	332 (4.5)	193 (5.1)	139 (3.9)
University and postgraduate	1,350 (18.3)	750 (19.7)	597 (16.6)
Other/refused	36 (0.5)	17 (0.5)	19 (0.5)
Displacement			
Displaced	621 (8.4)	320 (8.4)	301 (8.4)
Nondisplaced	6,775 (91.6)	3,480 (91.6)	3,290 (91.6)
Total	7,396 (100)	3,800 (100)	3,591 (100)

included 3,800 men (51%) and 3,591 women (49%), with a mean age of 27 years (range, 0–93 years). More than half of them (52.7%) were younger than 25 years, whereas only 6.6% were 60 years or older.

Male respondents were most commonly students (28.7%), self-employed (26.2%), and civil servants (16.2%), whereas the majority of female respondents were homemakers (48.5%) and students (25.2%). Of the sample population at or above school age, 6.1% were illiterate, with higher rates among women (9.5%) compared with men (2.9%) ($p < 0.001$). Individuals displaced as a result of war or sectarian violence comprised 8.4% of the sample population, with equal distribution by gender.

TABLE 2. Injury Incidence by Group

	Incidence Rate per 1,000 Person-Years (95% CI)	Relative Risk (95% CI)*
Sex		
Female	35.6 (24.4–50.3)	1.00
Male	74.8 (58.4–94.4)	2.56 (1.63–4.01)
Displacement		
Not displaced	51.4 (41.2–63.4)	1.00
Displaced	103.1 (58.9–167.4)	2.04 (1.17–3.55)
Education		
Illiterate	106.4 (55.0–185.9)	1.00
Elementary school	59.6 (41.3–83.3)	0.44 (0.23–0.86)
Secondary/high school	53.5 (35.5–77.3)	0.37 (0.19–0.75)
Vocational college/University	50.0 (30.9–76.4)	0.33 (0.16–0.70)
Overall	54.9	(45.5–67.6)

Injury Incidence

During the 3-month recall period, there were 103 reported injuries, corresponding to an injury incidence rate of 54.9 (95% CI, 45.5–67.6) per 1,000 person-years (see Table 2). This included three cases of injury-related death.

Regression analysis demonstrated that gender, displacement, and education correlated strongly with injury. Injury incidence was more than 2.5 times higher in men than women ($p < 0.001$), 2.0 times higher in displaced persons than nondisplaced ($p < 0.02$), and 2.5 times higher among illiterate individuals compared with those who had received at least an elementary school education ($p < 0.005$).

Table 3 shows additional differences in incidence patterns depending on age, with those older than 60 years at greatest risk of injury ($p < 0.05$). The highest subgroup injury incidence rates were among men between 16 years and 25 years.

Mechanism of Injury

Table 4 outlines mechanism of injury by gender and age. Falls (30.1%) and being struck or hit by person or object

TABLE 3. Incidence Rate by Age Distribution

	Incidence Rate per 1,000 Person-Years			Incidence Rate Ratio (95% CI)		
Category	Male	Female	Total	Male	Female	Total
0–5	36.6	20.6	29.0	1.00	1.00	1.00
6–15	86.0	29.1	58.7	2.35 (0.78–7.03)	1.42 (0.27–7.30)	2.02 (0.82–5.02)
16–25	112.4	15.4	66.1	3.07 (1.07–8.85)	0.75 (0.125–4.48)	2.28 (0.94–5.52)
26–45	73.7	36.8	55.6	2.01 (0.69–5.87)	1.79 (0.39–8.16)	1.91 (0.80–4.60)
46–59	20.9	60.2	40.9	0.57 (0.10–3.11)	2.92 (0.59–14.49)	1.41 (0.49–4.07)
≥60	66.9	96.8	82.1	1.83 (0.46–7.31)	4.71 (0.95–23.3)	2.83 (1.03–7.80)

TABLE 4. Mechanism of Injury by Gender and Age

	Total, n (%)	Gender, n (%)		Age Group, n (%)					
Types of Injuries		Male	Female	0–5	6–15	16–25	26–45	46–59	≥60
Traffic	9 (8.7)	8 (11.3)	1 (3.1)	1 (16.7)	0 (0)	3 (11.1)	3 (9.7)	1 (12.5)	1 (10.0)
Fall	31 (30.1)	19 (26.8)	12 (37.5)	2 (33.3)	9 (40.9)	6 (22.2)	6 (19.4)	2 (25.0)	6 (60.0)
Struck or hit by person or object	20 (19.4)	14 (19.7)	6 (18.8)	0 (0)	5 (23.8)	6 (22.2)	5 (16.1)	2 (25.0)	2 (20.0)
Stab	2 (1.9)	1 (1.4)	1 (3.1)	0 (0)	0 (0)	1 (3.7)	1 (3.2)	0 (0)	0 (0)
Gunshot	6 (5.8)	4 (5.6)	2 (6.3)	0 (0)	2 (9.5)	2 (7.4)	2 (6.5)	0 (0)	0 (0)
Fire, flames, or heat	4 (3.9)	2 (2.8)	2 (6.3)	1 (16.7)	0 (0)	0 (0)	2 (6.5)	1 (12.5)	0 (0)
Poisoning	14 (13.6)	9 (12.7)	5 (15.6)	1 (16.7)	4 (19.1)	4 (14.8)	4 (12.9)	1 (12.5)	0 (0)
Animal bite	1 (0.9)	0 (0)	1 (3.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (10.0)
Electric shock	5 (4.9)	5 (7.0)	0 (0)	0 (0)	0 (0)	1 (3.7)	4 (12.9)	0 (0)	0 (0)
Explosion	7 (6.8)	6 (8.5)	1 (3.1)	0 (0)	1 (4.8)	2 (7.4)	3 (9.7)	1 (12.5)	0 (0)
Other/refused/unknown	4 (3.9)	3 (4.2)	1 (3.1)	1 (16.7)	0 (0)	2 (7.4)	1 (3.2)	0 (0)	0 (0)
Total	103 (100)	71 (100)	32 (100)	6 (100)	21 (100)	27 (100)	31 (100)	8 (100)	10 (100)

TABLE 5. Injuries by Intention

Types of Injuries	Total, n (%)	Unintentional, n (%)	Intentional, n (%)
Traffic	9 (8.7)	8 (8.7)	1 (11.1)
Fall	31 (30.1)	30 (32.6)	0 (0)
Struck or hit by person or object	20 (19.4)	19 (20.7)	0 (0)
Stab	2 (1.9)	0 (0)	2 (22.2)
Gunshot	6 (5.8)	5 (5.4)	1 (11.1)
Fire, flames, or heat	4 (3.9)	4 (4.4)	0 (0)
Poisoning	14 (13.6)	14 (15.2)	0 (0)
Animal bite	1 (0.9)	1 (1.1)	0 (0)
Electric shock	5 (4.9)	5 (5.4)	0 (0)
Explosion	7 (6.8)	3 (3.3)	4 (44.4)
Other/refused/unknown	4 (3.9)	3 (3.3)	1 (11.1)
Total	103 (100)	92 (100)	9 (100)

TABLE 6. Location of Injuries

Locations of Injuries	Total, n (%)	Male, n (%)	Female, n (%)
Home	52 (50.5)	29 (36.6)	26 (81.3)
School	5 (4.9)	4 (5.6)	1 (3.1)
Street/highway	34 (33.0)	30 (42.3)	4 (12.5)
Sports and athletic area	5 (4.9)	5 (7.0)	0 (0)
Industrial and construction sites	2 (1.9)	2 (2.8)	0 (0)
Commercial area	4 (3.9)	3 (4.2)	1 (3.1)
Government offices	1 (0.9)	1 (1.4)	0 (0)
Total	103 (100)	71 (100)	32 (100)

(19.4%) made up around half of all injuries. Other common injuries included poisoning (13.6%) and traffic-associated (8.7%). Injuries resulting directly from arms—explosions (6.8%), gunshots (5.8%), and stabbings (1.9%)—accounted for less than a sixth of all injuries. Electric shock made up 7% of all male injuries, affecting men between 16 years and 45 years.

Intentional Injuries

Intentional injuries made up 8.9% of the total, with an incidence rate of 4.9 per 1,000 person-years (95% CI, 2.2–9.2; Table 5). Most intentional injuries were caused by explosion (44%), followed by stabbing (22%), gunshot (11%), and traffic (11%). Of the six injuries from gunshots, only one was deemed intentional by the respondent (17%).

Location of Injuries

More than half of all injuries occurred within households (50.5%), accounting for 81.3% of injuries among women and 36.6% among men ($p < 0.001$; Table 6). Male injuries were more likely to be on the street or highway than in the household (42.3% vs. 36.6%). A small proportion of injuries also occurred at athletic areas (7.0%), schools (5.6%), commercial areas (4.2%), industrial sites (2.8%), and government offices (1.4%). All injuries at athletic areas, industrial sites, and government offices occurred in men.

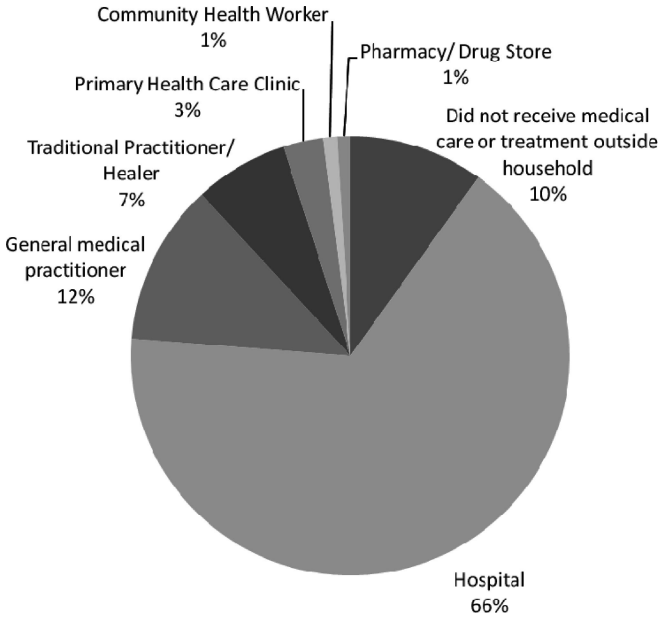

Figure 1. Medical care seeking.

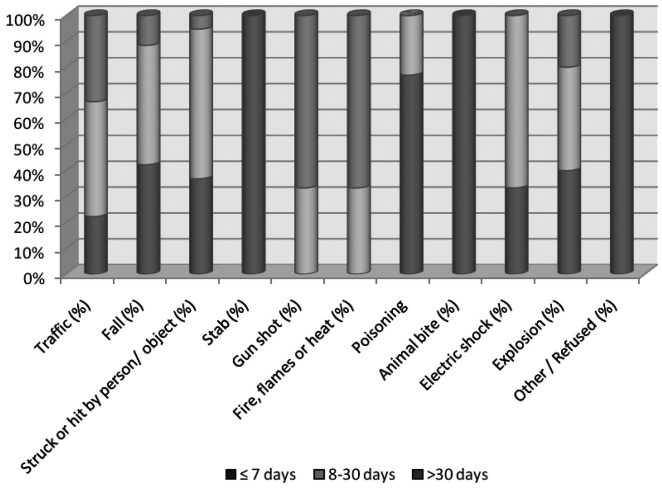

Figure 2. Days of normal activity lost by mechanism of injury.

Medical Care Seeking

The majority (88.4%) of injured people received medical treatment outside the household, without significant differences by gender or displacement. Of all the injuries reported during the 3-month recall, most presented to a hospital (66%), with one-third receiving hospitalization (Fig. 1). The mean length of stay was 6 days (range, 1–30 days), with 75.8% staying for a week or less.

General medical practitioners (11.7%) and traditional practitioners/healers (6.8%) also treated a small proportion. Among the few (9.7%) who did not seek medical care outside household, 40% perceived the injury as being not severe and only one (10%) reported mistrust in system or providers.

Postinjury

The mean number of days of normal activity lost as a result of injury was 19 days (range, 1–90 days). Close to half (48%) of all people injured lost over a week of normal activity, with around one-tenth (12%) reporting over a month lost. Among this latter group, the majority were from traffic or falls, followed by gunshots, fire, and explosion (Fig. 2).

Mortality

Seven cases of injury-related deaths occurred within the 12-month recall period, including from explosions, gunshots, and electrocutions. This resulted in a 1.7% (95% CI, 0.7–3.5%) proportionate mortality for injuries. Because of the small number of injury-related deaths, we performed no further mortality analysis.

DISCUSSION

Burden From Morbidity and Indirect Injury

We present results from a household cluster study of injury in the Baghdad governorate, with analysis of total burden for the population. Consistent with studies in nonconflict areas, even in a zone of active large-scale violence, fatalities represent only a small fraction (1.7%) of overall injury.

Our results show that, despite the ongoing violence in Iraq, a surprisingly small proportion of overall injuries were intentional (8.4%). Although variations in study methodology may account for some disparity, the rate of intentional injury found in our sample falls within the range seen in areas without large-scale group conflict (Table 7).[17–21]

The well-publicized intentional explosions in Baghdad (e.g., from Improvised Explosive Devices), although accounting for close to half (44%) of all intentional injuries, made up only 4% of total injuries within our sample population. However, we hypothesize that many of the unintentional injuries found in our study are indirectly attributable to the conflict-induced breakdown of Iraqi infrastructure. As an example, because of security problems, guns are ubiquitous within Baghdad. Our study demonstrated that only one in six gunshot injuries was intentional. However, it is likely that the unintentional gunshot injuries may, in part, result from to the easy access to arms and the lack of significant safety precautions in the country.

TABLE 7. Intentional Injury Proportions by Country

Country	Type	Intentional Injuries (as Percent of Total)	Reference
Pakistan (Afghan refugees)	All	15%	17
Nicaragua	Moderate and severe	1.5%	18
Nigeria (rural)	All	19%	19
Uganda (rural)	Fatal	21%	20
	Disabling	2%	
	Recovered	12%	
India (rural)	Nonfatal	3.5%	21

An inconsistent electric supply is another possible risk factor for injury that could be attributed to the breakdown of Baghdad's infrastructure. During the 2003 invasion, coalition forces targeted Iraq's electric grid. It remains incompletely rebuilt and electricity provision is intermittent. A 2007 survey indicated that Baghdad residents on average had only 5.0 h/d of electricity from the public network, supplemented by 6.6 h/d of electricity from community generators and 4.1 h/d of electricity from home generators.[16] Because of the faulty public electricity network, a web of exposed wires covers most of Baghdad, as residents attempt to improve their own individual access to the electricity grid. Unsurprisingly, electrocution accounts for 7% of all male injuries in our study, a burden that a functioning public service would likely reduce.

In addition, other less obvious causes of injury may also be attributable to the deficient electric grid. Because of the poor public supply, residents use and store other fuels in their homes. A 2007 survey found that 11.2% of Baghdad residents used kerosene as the primary source for cooking and 73.2% as the secondary source.[16] Residents typically store kerosene in unmarked water bottles and many of the poisonings found in our survey may have resulted from unintentional ingestions, a hypothesis supported by anecdotal reports from Iraqi doctors. Many of the unintentional explosions described in the study may similarly have been from explosions of fuel storage tanks within the home.

Finally, the relative preponderance of falls (30.8%) and unintentionally being struck or hit by a person or object (19.4%) may also be related to unmet electricity demands. Our interviewers report that many respondents noted both falling and being struck by objects in their home during the frequent blackouts. Adding to the risk of falls is the general disrepair of housing. A recent survey demonstrated that 25% of Baghdad residences had insufficient lighting, 69% lived in old or deteriorated buildings, and 84% had some type of housing deficiency.[16] More research needs to be done to identify proximate causes of such injuries.

Incidence Rates

Overall, our results indicate an injury incidence of 57.9 (95% CI, 47.5–70.0) per 1,000 person-years, which is comparable with other rates in the region (see Table 8), as well as estimates derived from the 2007 National Iraq Household Socio-Economic Survey.[16,17,22–24] Given the ongoing conflict in Baghdad, it is surprising that the overall injury rates in our study were not higher.

Multiple factors may account for this comparable injury rate. First, several of the reference regional studies also targeted high-risk populations.[17,22] Second, these studies used

TABLE 8. Injury Incident Rates by Country

Country	Rate (per 1,000 Person-Years)	Reference
Pakistan	45.9	23
Pakistan (Afghan refugees)	50.8	17
Syria	77.3	24
Iran (rural)	91	22

different sampling frames and methodologies, which may account for some variation. Third, we were unable to access a small subset of particularly dangerous neighborhoods, likely leading to underestimation of both intentional injuries and overall burden, a limitation that is possibly worsened when assessing injuries rates from conflict.[14]

Finally, periods of conflict may actually reduce some types of common injuries. Road traffic injuries were comparatively lower in our study, comprising the fourth most common mechanism of injury. Although Baghdad is a largely urban area, multiple security checkpoints throughout the city lower maximum vehicular speeds. This may indirectly cause a reduction in road traffic injury.

Risk Factors

Similar to injury studies in nonconflict areas,[17,19,22] male risk (78.0 per 1,000 person-years) was significantly higher than female risk for injury (36.8 per 1,000 person-years). Male injury occurred more frequently outside the home, compared with injuries in women, likely because of the societal distribution of work responsibilities.

In addition, our results also showed double or more risk of injury within the elderly, displaced, and illiterate. These findings provide potential risk factors for health workers striving to mitigate injuries during conflict. For Internally Displaced Persons (IDPs), this is consistent with other studies of risk in Iraq, which indicate that they may suffer from a relative lack of access to basic utilities including food, water, and electricity.[25]

A unique household-based study of injury in an active conflict zone, this survey provides an in-depth assessment of overall injury burden and epidemiology in Baghdad. Its results describe injury morbidity, including the indirect impact of infrastructure breakdown from conflict. This data will be a useful guide to future injury prevention and treatment efforts in conflict areas.

Limitations

Research within an area of active conflict, such as Iraq, is fraught with inherent limitations, including security restrictions on movement and supervision. Although managed in the field by IMC personnel, we used Iraqi Ministry of Health staff to gather survey data, which theoretically may have decreased participants' willingness to indicate injuries were intentional.

Another limitation to the analysis of our study is that we know of no reliable data for injury incidence rates and epidemiology in Baghdad before the 2003 invasion. This significantly hampers any conclusions we can make draw from the study.

In addition, security within Iraq is fluid and rapidly changing, resulting in the flux of the proportion and type of intentional injuries during any given time period. Although coalition military casualties decreased concurrent with a reduction of US troop presence and interaction in 2009, persistent acts of group violence continued to affect the civilian populace throughout the study period.[26] However, caution should be maintained when trying to generalize our results to other periods, especially the height of the fighting in 2006 to 2007 and the initial invasion in 2003.

ACKNOWLEDGMENTS

We thank personally His Excellency Dr. Saleh Hasnawi, Iraq Minister of Health; Dr. Chasib L. Ali, Director General of Medical Operation and Specialized Services, Iraqi Ministry of Health; and Dr. Hasnaa Rustami, Developing Programs Director, Medical Operation and Specialized Services, Iraqi Ministry of Health, and their supporting staff. In addition, we would like to thank the Baghdad Injury Survey Team: Wisam Qasem Mahmood, Amin Tareq Muslem, Dhiya'a A.alrazaq, Khalil Ali, Mohannad Monther, Fahad, Salah D. Jamil, Sa'ad Hassan Farhan, Heba Waleed, Manal A. Naori, Ammar A. Sharad, Muthana Ali Kadhum, Huda Karem, Wajeda Mahdi, Ali Mohamad Ali, Naser Sa'adi Mohamad, Firas Ya'aqub, Eshraq Hassan Salman, Amer Taleb, Mohammad Salah, Omar Rashed, Ahmed Kadhum, Salah Hassan, Haider Mohammad, Ali Ahmed, and Haider Mosa. We also thank Drs. Sharaf Aziz, Waleed Ansari, and Muhannad Hamammy for comments on data results and clinical correlations and Qendresa Latifi for editing assistance.

REFERENCES

1. United Nations Office for the Coordination of Humanitarian Affairs. *Baghdad Governorate Profile*. Iraq: Inter-Agency Information and Analysis Unit. 2009.
2. Degomme O, Guha-Sapir D. Patterns of mortality rates in Darfur conflict. *Lancet.* 2010;375:294–300.
3. Depoortere E, Checchi F, Broillet F, et al. Violence and mortality in West Darfur, Sudan (2003–04): epidemiological evidence from four surveys. *Lancet.* 2004;364:1315–1320.
4. Coghlan B, Brennan RJ, Ngoy P, et al. Mortality in the Democratic Republic of Congo: a nationwide survey. *Lancet.* 2006;367:44–51.
5. Ahoua L, Tamrat A, Duroch F, Grais RF, Brown V. High mortality in an internally displaced population in Ituri, Democratic Republic of Congo, 2005: results of a rapid assessment under difficult conditions. *Global Public Health.* 2006;1:195–204.
6. Van Herp M, Parque V, Rackley E, Ford N. Mortality, violence and lack of access to health-care in the Democratic Republic of Congo. *Disasters.* 2003;27:141–153.
7. Awqati NA, Ali MM, Al-Ward NJ, et al. Causes and differentials of childhood mortality in Iraq. *BMC Pediatr*. 2009;9:40.
8. Burnham G, Lafta R, Doocy S, Roberts L. Mortality after the 2003 invasion of Iraq: a cross-sectional cluster sample survey. *Lancet.* 2006; 368:1421–1428.
9. Iraq Family Health Survey Study Group; Alkhuzai AH, Ahmad IJ, Hweel MJ, et al. Violence-related mortality in Iraq from 2002 to 2006. *N Engl J Med.* 2008;358:484–493.
10. Roberts L, Lafta R, Garfield R, Khudhairi J, Burnham G. Mortality before and after the 2003 invasion of Iraq: cluster sample survey. *Lancet.* 2004;364:1857–1864.
11. Siegler A, Roberts L, Balch E, et al. Media coverage of violent deaths in Iraq: an opportunistic capture-recapture assessment. *Prehosp Disaster Med.* 2008;23:369–371.
12. Spiegel PB, Salama P. War and mortality in Kosovo, 1998–99: an epidemiological testimony. *Lancet.* 2000;355:2204–2209.
13. Hicks MH, Dardagan H, Serdan GG, Bagnall PM, Sloboda JA, Spagat M. The weapons that kill civilians—deaths of children and noncombatants in Iraq, 2003–2008. *N Engl J Med.* 360;16:1585–1588.
14. Aboutanos MB, Susan PB. Wartime civilian injuries: epidemiology and intervention strategies. *J Trauma.* 1997;43:719–726.
15. World Health Organization. *Guidelines for Conducting Community Surveys on Injuries and Violence*. Geneva, Switzerland: World Health Organization; 2004.

16. Central Organization for Statistics and Information Technology of Iraq. *Tabulation Report: The Iraq Household Socio-Economic Survey 2007*. Baghdad: COSIT; 2008.
17. Hyder AA, Ghaffar A, Masud TI, et al. Injury patterns in long-term refugee populations: a survey of Afghan refugees. *J Trauma.* 2009;66:888–894.
18. Tercero F, Andersson R, Pena R, Rocha J, Castro N. The epidemiology of moderate and severe injuries in a Nicaraguan community: a household-based survey. *Public Health.* 2006;120:106–114.
19. Olawale OA, Owoaje ET. Incidence and pattern of injuries among residents of a rural area in South-Western Nigeria: a community-based study. *BMC Public Health.* 2007;7:246.
20. Kobusingye O, Guwatudde D, Lett R. Injury patterns in rural and urban Uganda. *Inj Prev.* 2001;7:46–50.
21. Cardona M, Joshi R, Ivers RQ, et al. The burden of fatal and non-fatal injury in rural India. *Inj Prev.* 2008;14:232–237.
22. Rezapur-Shahkolai F, Naghavi M, Vaez M, Shokouhi M, Laflamme L. Injury incidence, healthcare consumption and avenues for prevention: a household survey on injury in rural Twiserkan, Iran. *Public Health.* 2009;123:384–389.
23. Fatmi Z, Hadden W, Razzak J, Qureshi HI, Hyder AA, Pappas G. Incidence, patterns and severity of reported unintentional injuries in Pakistan for persons five years and older: results of the National Health Survey of Pakistan 1990–94. *BMC Public Health.* 2007;7:152.
24. Maziak W, Ward KD, Rastam S. Injuries in Aleppo, Syria; first population-based estimates and characterization of predominant types. *BMC Public Health*. 2006 Mar 13;6:63.
25. International Organization for Migration. Iraq displacement & return 2008 mid-year review. Available at: http://www.iom-iraq.net/Library/Iraq%20Displacement%20and%20Return%20Mid-Year%20Review%202008.pdf. Accessed February 5, 2010.
26. Iraq Body Count. Documented civilian deaths from violence. Available at: http://www.iraqbodycount.org/database/. Accessed July 21, 2010.