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Article

Exposure to conflict-related violence and nutritional status of children in Iraq

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ABSTRACT

There is limited empirical evidence of the health effects of war-related violence on child nutritional status. Using unique micro-level data from Iraq, we create measures of cumulative exposure to violence since conception for children ages two to five based on their date of birth and geographic location. We examine the relationship between height-for-age z-scores, a measure of chronic malnutrition, and four indicators of violence in a regression framework, adjusting for potential confounders and trends. We find that a child exposed to the maximum number of violent incidents is likely to experience a 0.5 standard deviation reduction in height-for-age z-score compared to a child who is exposed to no incidents. Each type of attack we evaluate is negatively associated with height-for-age. Further analysis reveals that the associations are the strongest for children in the northern and central regions where the bulk of the violent incidents occurred. Contrary to our expectation, the associations are similar for boys and girls. Our findings suggest that, in addition to efforts aimed at decreasing violent conflict in Iraq in general, the government and its development partners should focus relief, recovery, and reconstruction efforts in the central and northern regions of the country.

1. Introduction

Violent conflicts have surged in recent years (The World Bank, 2018). In 2017, more countries were in a state of violent conflict than in any given year in the past 30 years (Uppsala Conflict Data Program, 2019). Almost all conflicts leave behind a trail of human suffering and displacement. For children and youth, the effects of exposure to violence manifest in multiple forms (Miller & Rasmussen, 2010), including reduced ability to internalize problems (Betancourt, Mcbain, Newnham, & Brennan, 2014) and psychological distress (Blattman & Annan, 2010). Exposure to conflict in infancy also increases the risk of subsequent mortality (Wagner et al., 2018).

We contribute to an emerging body of literature that examines the relationship between exposure to conflict on children's physical health, primarily nutritional status. Several studies have found that exposure to conflict adversely affects height, a marker of chronic malnutrition, across a number of countries, including Burundi (Bundervoet, Verwimp, & Akresh, 2009), Nigeria (Akresh, Bhalotra, Leone, & Osili, 2012), Eritrea (Akresh, Lucchetti, & Thirumurthy, 2012), and Cote d'Ivoire (Minoiu & Shemyakina, 2014).

Our key contributions to the existing literature are twofold. First, we investigate the association between exposure to violence and child nutritional status in the context of Iraq, a country that has experienced prolonged conflict and is an active combat zone. The war in Iraq commenced in 2003, and sectarian violence continues in many parts of the country, even as we write this paper. An examination of the adverse health consequences of this active conflict can assist policymakers to design and implement remedial policies quickly and potentially avert further damage.

The consequences of conflict in Iraq are also important given their sheer magnitude. Three countries—namely, Afghanistan, Iraq, and the Syrian Arab Republic—incurred more than 76% of all war-related fatalities in 2016 (Kendra & Siri Aas, 2017). Yet, to our knowledge, there are a limited number of studies examining how exposure to violence has affected children's physical health in these countries. In Iraq, several studies have examined the nutritional status of children in the current climate and in relation to violence (Ghazi et al., 2014; Ghazi, Mustafa, Aljunid, Md. Isa, & Abdalqader, 2013). However, these studies are

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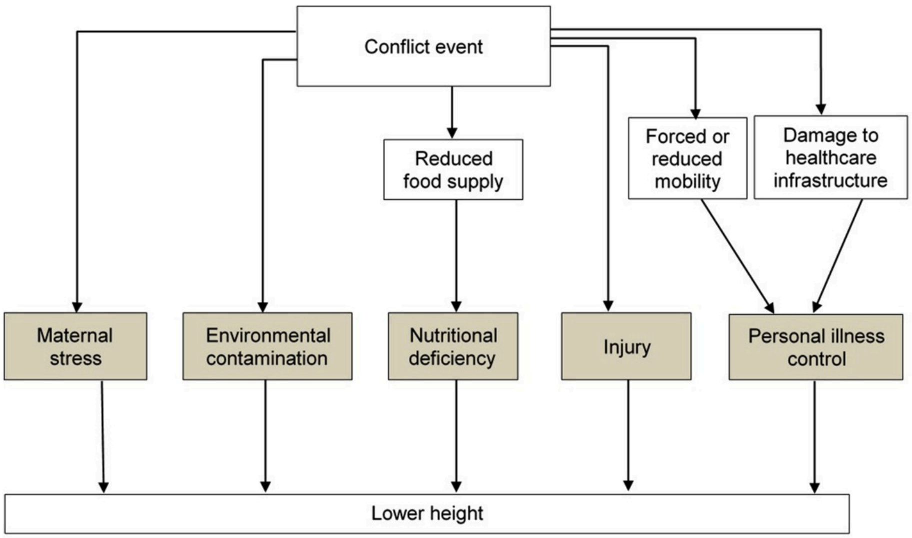

Fig. 1. Mechanisms linking conflict to height.
Notes: This framework is adapted from Mosley and Chen (1984), which shows how five groups of proximate determinants operate on the health dynamics of children (shaded boxes). In this adapted version, we link a conflict event to nutritional status as reflected in a child's height. We added the remaining boxes based on example mechanisms from existing studies.

limited to the Baghdad governorate and provide no information on the extent of these effects throughout the country.

Our second contribution is to examine how the relationship between exposure to violence and child nutritional status differs by gender and geographic region. Few studies on the conflict-nutrition nexus have examined gender differences, and those that have, including studies in Eritrea (Akresh et al., 2012) and Cote d'Ivoire (Minoiu & Shemyakina, 2014), find similar effects for boys and girls. However, gender differences in the association of conflict and child nutrition could be heightened in settings where gender inequality is particularly severe, such as Iraq. In 2018, Iraq ranked among the lowest in terms of gender equality in socioeconomic, health, and political domains globally (ranking 147 out of 149 countries on the Global Gender Gap Index) (World Economic Forum, 2018). Furthermore, although accurate data on children's health status are difficult to obtain, it appears that Iraqi girls were at a disadvantage before the war began in 2003. Analysis of healthcare utilization data from the 2000 Multiple Cluster Indicator Survey (MICS) shows that girls were less likely than boys to receive vitamin A supplementation, to receive oral rehydration salts for diarrhea, and to be taken to a clinic for a suspected case of pneumonia (authors' calculations). Thus, our study in Iraq fills an important gap in the research on gender differences in the association between war and child health.

We also examine heterogeneous associations by geographic region. Although all regions within Iraq have been exposed to conflict, there is variation in the nature and extent of exposure (International Organization for Migration, 2018; World Health Organization, 2014). The northern region has been the locus of much of the conflict. The central region, especially Baghdad, experiences conflict as well as spillover from these conflicts, notably by absorbing internally displaced people. The southern region exhibits a high rate of chronic poverty but has been relatively sheltered from recent sectarian violence. Finally, the Kurdistan region in the northeast has also experienced less violence than the northern and the central regions.[1] An examination of how the association between violence and child height varies geographically will enable policymakers to target programs more accurately based on regional needs.

2. Mechanisms

We are among the first to examine the association between violent conflict and child height thoughout Iraq. Given data limitations, described below, we are unable to explore the mechanisms linking conflict to child nutrtitional status, however. Nevertheless, we have developed a framework noting various channels through which exposure to conflict could operate to help interpret our results and guide future research.

We modify Mosley and Chen's proximate determinants of child health framework (Mosley & Chen, 1984) with insights from previous studies on conflict (Grossman, Khalil, & Ray, 2019; Guha-sapir & Olivia D'Aoust, 2010) and additional research (see Fig. 1). The proximate determinants of height include child injury, maternal factors, environmental contamination, nutrional deficiency, and personall illness control (health care utilization). Conflict could impact several of the proximate determinents directly or operate through other important distal factors that in turn affect one or more of the proximate determinants.

With respect to direct effects, maternal stress is one of the routes through which exposure to conflict can affect a child's stature. Maternal stress and depression during pregnancy have been shown to increase the incidence of low birth weight and raise the risk of low gestational age (Farías-Antúnez, Xavier, & Santos, 2018; Rondó et al., 2003; Surkan, Kennedy, Hurley, & Black, 2011), both of which can affect child height. Acute physical and mental stress is also linked to a reduction in lactation (Dewey, 2001) and reduced breastfeeding (Mezzacappa, 2004), both of which affect child growth. Environmental contamination could occur as a result of violent conflict. For example, conflict and war can impact water quality, which is in turn linked to an increased risk of waterborne diseases and malnutrition among children (Cooten, Gebremedhin, & Spigt, 2019; Johri, Sylvestre, Kone, Chandra, & Subramanian, 2019).

One important mechanism through which violent conflict could affect child height is the disruption in food supply, which can produce child nutritional deficiencies. For example, attacks could damage existing infrastructure or create a sense of fear, thereby interrupting local trade (Grossman et al., 2019). The resulting decrease in economic activity could raise household-level food insufficiency (Desai, 2017;

[1] The northern region consists of Nineveh, Kirkuk, Diyala, Anbar, and Salah al-din governorates; the central region consists of Baghdad, Babylon, Kerbala, Najaf, and Wasit governorates; the southern region consists of Qadisiya, Muthanna, Thi Qar, Missan, and Basrah governorates; finally, Kurdistan consists of Duhok, Erbil and Sulaimaniya governorates.

Jackson, Johnson, Vaughn, & Hinton, 2019). If the supply of agricultural inputs, such as seeds and fertilizers, is disrupted, crop output can fall, reducing food availability more directly. An estimate by the Food and Agriculture Organization suggests that per-capita agricultural production falls by 1.5% per year during an armed conflict (Teodosijević, 2003). When the amount and types of food available to children are reduced, their growth is compromised (Kuche et al., 2020).

Finally, various consequences of violent conflict can affect healthcare access and utilization, such as reduced population mobility and damaged healthcare infrastructure (Allotey & Reidpath, 2019; Lutz & Mazzarino, 2019). For example, a study in Sub-Saharan Africa showed that geographical and temporal proximity to various types of violent conflict, including armed insurgents, significantly reduced the likelihood of institutional births (Østby et al., 2018). Reduced access to and utilization of prenatal and postnatal care and child health services could affect fetal, infant, and child health and nutrition and therefore height.

Based on the above discussion, we hypothesize a negative relationship between violence and child height. Our framework also implies that a child could be adversely affected by conflict in utero through the channels of maternal stress and diet, for instance, which could ultimately impact height. An extensive review by Currie and Vogl suggests that exposure to adverse shocks, such as famine, diseases, and pollution, in utero substantially hampers children's long-term health, including height, and educational and labor-market outcomes (Currie & Vogl, 2013). Other studies have confirmed that in utero exposure to armed conflict affects child health (Currie, Mueller-Smith, & Rossin-Slater, 2018; Oskorouchi, 2019).

We are also interested in variation in the association between conflict and child health by gender and geographic region. Multiple mechanisms could operate differentially to influence the nutritional status of girls and boys, particularly in settings where gender discrimination is already manifest. For example, in times of food scarcity, parents could favor feeding sons over daughters, as was found in a study of adolescents in Ethiopia (Hadley, Lindstrom, Tessema, & Belachew, 2008). With respect to geographic location, violent conflict could differentially affect regional social and economic activities, such as water and sanitation systems, food supply channels, or medical facilities, which impact the proximate determinants of child nutritional status.

3. Material and methods

Data sources We combine data from two sources. Data on various types of violence, our key independent variables, are from the Empirical Study of Conflict (ESOC) project (ESOC, n.d.) and are publicly available (https://esoc.princeton.edu/). The ESOC project prepared these unique data from 193,264 Multi-National Forces Iraq (MNF-I) Significant Activity Reports by US Coalition forces (Berman, Shapiro, & Felter, 2011). Berman et al. (2011) provide details on these reports as well as the ESOC data used in this study. Briefly, the Activity Reports contain information on the district, date, and type of attack—e.g., direct weapons fire, suicide bombing, etc.—for all insurgent attacks that targeted Coalition forces, Iraqi forces, civilians, infrastructure, and government. These incidents were recorded for every month between February 2004 and February 2009.

Given that these data were initially collected by Coalition forces to inform their operations, data collection was likely systematic. However, the compilers of this dataset acknowledge several notable limitations. For example, the incidents in the ESOC project were recorded only when U.S. forces were present and, as such, they undercount sectarian violence (Berman, Condra, Felter, & Shapiro, 2012). The data also do not include coalition-initiated events, such as raids where no one returned fire, or coalition-initiated indirect fire attacks not triggered by an initiating insurgent attack (Berman et al., 2011). Finally, some information could be under- or misreported if Coalition forces units differentially designated an event as an incident or by type (Berman et al., 2012). The ESCO data were used in a study by Berman et al. (2011), which found that districts that received higher levels reconstruction spending by the United States experienced a significant reduction in insurgent violence.

Data on the nutritional status of children are from the 2011 Multiple Indicator Cluster Survey (MICS) for Iraq (UNICEF, 2019). The MICS is an international household survey program developed by UNICEF in the 1990s. The 2011 MICS for Iraq is a nationally representative survey of households. For children below the age of five in each sampled household, anthropometric information was collected, including height. The method used to measure child height (or length for children under 2 years) is standard across MICS in all countries and is outlined in the MICS manual (UNICEF, 2019).[2]

Study sample The 2011 Iraq MICS contains age and anthropometric information on 36,307 children ages zero to 59 months.[3] Of these children, we are able to match 33,731 (92.9%) to the conflict data using their district of residence.[4] The conflict data are available for all months between February 2004 and February 2009, whereas the children in the MICS were born between February 2006 and April 2011. The overlapping dates in the two data sources are, thus, February 2006 (i.e., the birth month of the oldest children in the MICS data) to February 2009 (the last month for which violence data are available). In the MICS data, 18,776 children were born during this period. Information on height is missing for 577 children. Therefore, our final analytic sample includes 18,199 children born between February 2006 and February 2009. As such, these children were between ages 23–59 months at the time of the 2011 MICS.

Measures. We use child height-for-age z-scores as the dependent variable in our analyses. Z-scores reflect a given child's height relative to the distribution of height of children of the same age and sex in the well-nourished international reference population (World Health Organization, 2006).[5] Low height-for-age is an indicator of chronic malnutrition,

[2] To measure a child's height, a measurer and an assistant placed a measuring board on a hard flat surface against a wall. They asked the child's caretaker or mother to remove the child's shoes and socks, place the child standing by the board (if above age 2), hold their hands above the child's ankles on the shins, and make sure that the child's legs were straight and their heels and calves were against the board. The measurer told the child to look straight ahead at the mother and lowered a headpiece on top of the child's head. The measurer called out the measurement to the nearest 0.1 cm to the assistant. The assistant recorded it and repeated it aloud to the measurer to confirm. The measurer checked the recorded measurement on the questionnaire for accuracy and legibility and instructed the assistant to correct any errors. For children under age 2, the measurement was taken lying down. Only one measurement was taken, except when the recorded height was not within an expected range.

[3] The dataset contains information on 36,599 children. However, information on age is missing for 292 children. 36,599–292 = 36,307.

[4] We are unable to match the entire sample of children primarily because geographic territories, such as governorates and districts, continue to be redefined and relabeled in Iraq. For example, in 2006, Iraq had 102 districts (Library of Congress, 2006), whereas there are currently 120 districts. There are 104 unique district names in the ESOC data and 118 unique district names in the MICS data. Overall, we were able to match 104 districts.

[5] The 2011 MICS uses the 2006 WHO reference population, which consists of 8440 healthy, breastfed children from widely diverse ethnic backgrounds and cultural settings (Brazil, Ghana, India, Norway, Oman, and USA). The z-scores range from −6 to 6, and a child below a z-score of −2 is considered stunted, while a z-score above −2 is considered normal.

resulting from inadequate nutrition and other deficiencies over a long period (Cashin & Oot, 2018; Currie & Vogl, 2013). The 2011 MICS generated normalized measures of nutritional status, including height-for-age and weight-for-age z-scores.[6]

Our key independent variables are measures of cumulative exposure to various types of violent conflict in a child's current district of residence since the month the child was conceived. The ESOC project provides information on various types of violent incidents that occurred in Iraq by month and district. These include data on the number of (1) improvised explosive devices (IEDs), (2) direct weapons fire, (3) indirect weapons fire,[7] (4) suicide bomb attacks, (5) criminal attacks, such as looting or murders as a result of or following combat violence, and (6) a category of other types of non-specified attacks. We use four measures of attacks for our analysis. The first measure is the number of all attacks (categories 1 to 6), which allows us to examine the overall impact of war-related violence. The second measure is the number of all attacks with the exception of criminal attacks (all categories except 5), which enables us to focus on combat violence between insurgents and Iraqi/coalition forces. The third and fourth measures are IED (category 1) and direct weapons fire (category 2) attacks, separately. We focus on these two types, as they form the largest proportion of attack types and we aim to explore their distinct impacts. We do not examine attacks related to indirect weapons fire, suicide bombings, and other non-specified types separately due to the low prevalence of these types.

All children in our sample are conceived after the war started. Therefore, for each child, we calculate four measures of cumulative exposure to violence by adding the number of incidents (pertaining to that measure) in the child's current district of residence since the month she or he was conceived (9 months before the month of birth) until the last month of available conflict data, February 2009. For example, the oldest child in our sample (age 59 months in 2011) was born in February 2006. For this child, cumulative exposure to IEDs is the total number of IEDs recorded in the child's district between June 2005 (month of conception) and February 2009 (the latest month for which we have conflict data). Likewise, for the youngest child in our sample, born in February 2009 and age 23 months in 2011, cumulative exposure to IEDs is the total number of IEDs recorded in the child's district between June 2008 (month of conception) and February 2009. We conduct an additional analysis to see if the inclusion of younger children—those for whom we have exposure data only while they were in utero (i.e., born during the nine months between March 2009 and November 2009)—changes the results.

Following Berman et al. (2011), we then normalize the resulting numbers of cumulative attacks using the World Food Program's district population estimates in 2003, also available from the ESOC project (Berman et al., 2011; ESOC, n.d.). Our measures of violence can be interpreted as "the number of violent incidents per 1000 population in a district to which the child was exposed since being conceived." This is analogous to per capita measures multiplied by 1000 and indicates the population-weighted intensity of exposure. Normalizing the number of incidents by the district's population acknowledges that children living in two different districts may be exposed to the same number of incidents yet are affected differently based on the concentration of population in those districts.

Using these district-level measures of conflict, we make the assumption that all children in a district are equally exposed to the violent incidents in that district in a particular month. The ESOC data do not include point data allowing us to link specific attacks to the location of individual children. Nevertheless, many of the mechanisms linking conflict and child height could likely operate at the community level; for example, attacks disrupting supply chains or health facilities could affect children with a geographic area similarly. Several existing studies of the conflict-nutrition nexus also use cumulative community-level indicators to define exposure. For example, in Bundervoet et al. (2009) calculate exposure to Burundi's civil war based on whether a child lived in a province that experienced the civil war or not. Akresh, Bhalotra, et al. (2012) and Akresh, Lucchetti, et al. (2012) define exposure to the Eritrea-Ethiopia conflict based on a child's region of birth. Using available information on the locations of incidents and children's survey clusters (a geographic sampling unit),[8] Østby et al. (2018) calculate exposure as the number of incidents within a set radius from the child's cluster.

In our regression analysis, we control for several factors that have been shown to influence child nutritional status. In addition to gender and age, we include mother's education. Mother's education has been established as a strong predictor of a child's nutritional status (Guldan et al., 1993; Variyam, Blaylock, Lin, Ralston, & Smallwood, 1999; Vereecken, Keukelier, & Maes, 2004). We account for household size, given that the number of individuals may affect the amount of food and other resources available to each individual (Olayemi, 2012). Other covariates include household access to an improved source of water (yes/no) and sanitation (yes/no), which we create following WHO/UNICEF guidance (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, n.d.). We also include variables for urban location (yes/no), and a wealth index.[9] MICS creates the wealth index from several items related to household assets (e.g., radio, refrigerator), housing characteristics (e.g., type of flooring), and utilities and infrastructure (e.g., number of persons sleeping per room). The method used is similar to the one employed by the Demographic and Health Surveys, whereby Principal Components Analysis is conducted to generate a wealth index score for each household (Rutstein & Johnson, 2004). Households in the full MICS sample are divided into quintiles based on the index. The MICS dataset also contains information on which of the 18 governorates the child resides. We divide these governorates into four regions (see footnote 1). We use these covariates as coded and provided in the MICS, with the exception of the dichotomous variables for water and sanitation, which we constructed. The categories for each variable are shown in Table 1.

Statistical analysis To evaluate the association between exposure to violence and height-for-age z-scores at the individual level, we estimate the coefficients in the following regression:

[6] We do not use two other common anthropometric measures of children's nutritional status, namely low weight-for-height and low weight-for-age, as these measures depend on short-term nutritional intake and tend to fluctuate in the short term (Cashin & Oot, 2018, pp. 93–115). In our analytic sample, we do not have data on conflict exposure during the last two years of their lives, as the conflict data end in February 2009 and the MICS survey was conducted in 2011. Weight-for-height and weight-for-age as measured in 2011 could reflect the effect of events that may have occurred during this period rather than the effect of exposure to earlier conflict.

[7] Direct weapons fire and indirect weapons fire differ in terms of the location of the target and the type of weapon used. "Direct fires are employed when the target is within line of sight, and the weapon can be aimed directly at the target. These are often employed by tanks, field guns, shoulder-fired infantry weapons, and many air-delivered munitions. In contrast, indirect fires are most commonly employed when the target is not within line of sight … [Such weapons] include artillery guns, mortars, rocket systems, and guided missiles" (Dullum, Kenton, Jenzen-Jones, Lincoln-Jones, & Palacio, 2017, p. 12).

[8] The study uses data from the Demographic and Health Surveys (DHS), which sample clusters, known as primary sampling units (PSUs). The geographic coordinates that the study uses are available for these clusters.

[9] A household is categorized as having access to an improved source of drinking water if the household reports using water from the following sources: piped water into dwelling, plot or yard; public tap/standpipe; tubewell/borehole; protected dug well; protected spring; and rainwater collection. A household is categorized as having access to improved sanitation if the household reports using a latrine with flush to piped sewage system, septic tank, pit latrine or an unknown place; a pit latrine with slab, a composting toilet or a ventilated improved pit.

Table 1
Summary statistics for the analytical sample (N = 18,199).

Variable	Mean (standard deviation)			p-value (stunted *vs* not stunted)
	Analytic sample (N = 18,199)	Stunted (N = 3735)	Not-stunted (N = 14,464)	
Child nutrition				
Height-for-age z-score	−1.02 (1.42)	−2.96 (0.92)	−0.52 (1.03)	<0.001
Number of incidents per 1000 population				
All attack incidents	3.60 (8.26)	3.90 (8.70)	3.52 (8.14)	0.011
All attacks (excluding criminal incidents)	3.19 (7.42)	3.48 (7.80)	3.11 (7.31)	0.008
IED incidents	2.01 (4.53)	2.19 (4.70)	1.97 (4.48)	0.009
Direct fire incidents	0.90 (2.56)	1.00 (2.74)	0.88 (2.50)	0.009
Child-level indicators				
Girls, %	50.40	50.12	50.54	0.642
Age (in months)	41.60 (9.92)	40.45 (9.73)	41.90 (9.95)	<0.001
Mother's education, %				
None	24.56	29.13	6.18	<0.001
Primary	50.73	51.00	49.99	
Secondary +	24.47	19.87	43.83	
Household-level indicators				
Household size	8.44 (4.31)	8.72 (4.53)	8.37 (4.25)	<0.001
Access to improved sanitation, %	95.09	94.38	95.15	<0.001
Access to clean drinking water, %	77.08	73.38	78.18	<0.001
Quintiles of wealth index, %				
Poorest	34.33	39.79	32.90	<0.001
Second	24.32	24.44	24.29	
Middle	18.51	16.79	18.96	
Fourth	13.54	11.54	14.06	
Richest	9.30	7.44	9.79	
Urban	53.55	48.32	54.63	<0.001

Source: Author's analysis of data from the ESOC project and MICS data.
Note: The first column shows the descriptive statistics for the analytic sample. The second and the third columns show the statistics separately for children who are stunted (height-for-age z-score < -2) and those who are not stunted. The p-values are from a test of difference between stunted and not stunted.

$$HAZ_{ijkt} = \alpha_k + \theta_t + \pi_1 Violence_{jk} + \delta R_{ijkt} + v_{ijk} \quad (1)$$

In this equation, HAZ_{ijkt} is the height-for-age z-score for a child *i* born in year-month *t* living in district *j* in governorate *k* as measured in 2011, the time of the MICS. *Violence* is a continuous variable reflecting the cumulative level of population-weighted violence in the child's district since conception. With the inclusion of the governorate random effects, α_k, we utilize the within-governorate as well as between-governorate variation in measures of conflict. θ_t are birth year and birth calendar month fixed effects, accounting for the overall trend in HAZ over time. ***R*** is a vector of individual and household characteristics, such as gender, mother's education, household wealth, and urban location. v_{ijt} is the usual error term. We cluster the standard errors at the governorate level, thus allowing observations within a governorate to be arbitrarily correlated with each other.

In this equation, π_1 is the key coefficient of interest. It captures the relationship between a child's cumulative exposure to violence and his or her height-for-age z-score recorded in 2011, on average. The expected sign on π_1 is negative.

There is no consensus in the literature on how to assess exposure to violent conflict. Therefore, we perform an additional analysis using an alternative operationalization of cumulative violence. Specifically, we assess the impact of conflict weighted by area rather than population by calculating exposure to conflict as the "cumulative number of incidents per square kilometer". This measure assesses if the same number of incidents has a higher impact on children's height in districts that are geographically small compared to districts that are large.

To evaluate the heterogeneous association of exposure to violence and height by gender, we estimate equation (1) separately for boys and girls. We also evaluate the heterogeneous association of exposure to violence and height by geographic region by estimating equation (1) separately for each of the four regions. We conducted all analyses in Stata version 15 (StataCorp, 2017).

4. Results

4.1. Descriptive results

In our analytic sample of 18,199 children ages 23–59 months, the mean height-for-age z-score is −1.02 and 20.5% are categorized as stunted (a height-for-age z-score of −2 or less) (Table 1). The nutritional status of these Iraqi children is worse, on average, than that of children in other countries also categorized as upper-middle-income by the World Bank, such as Jordan, Turkey, and Iran. In upper-middle-income countries overall, only 6.3% of under-five children are stunted (United Nations Children's Emergency Fund, 2019).[10]

The mean cumulative exposure to violence, based on the total number of attacks reported in the child's district since conception until February 2009, is 3.6 incidents per 1000 population (range: 0 to 87). On average, the children have been exposed to 3.2 non-criminal attack incidents (range: 0 to 78), 2.1 IED incidents (range: 0 to 46), and 0.9 direct weapons fire incidents (range: 0 to 30) per 1000 population since conception. The average age of children is 42 months. There are roughly equal proportions of boys and girls in the sample. Approximately 25% of mothers have no education, 51% have primary education, and 24% have secondary education or more. The average household size is 8.4 persons, likely reflecting relatively high fertility (the total fertility rate in Iraq was 3.8 in 2017 (The World Bank, 2020)) and extended family households. In our sample, 95% of children have access to an improved latrine and 77% have access to clean water. Approximately 60% of children are from the poorest and the second poorest wealth quintiles of households in the overall MICS dataset. Fifty-four percent live in urban areas.

We also report each independent variable by child stunting status in Table 1. Children who are stunted and those who are not stunted differ significantly in terms of their socio-economic characteristics. For

[10] Note that the prevalence rate in our analytic sample was lower than the 22.5% stunting rate reported by UNICEF for Iraq for 2011 (https://data.unicef.org/topic/nutrition/malnutrition).

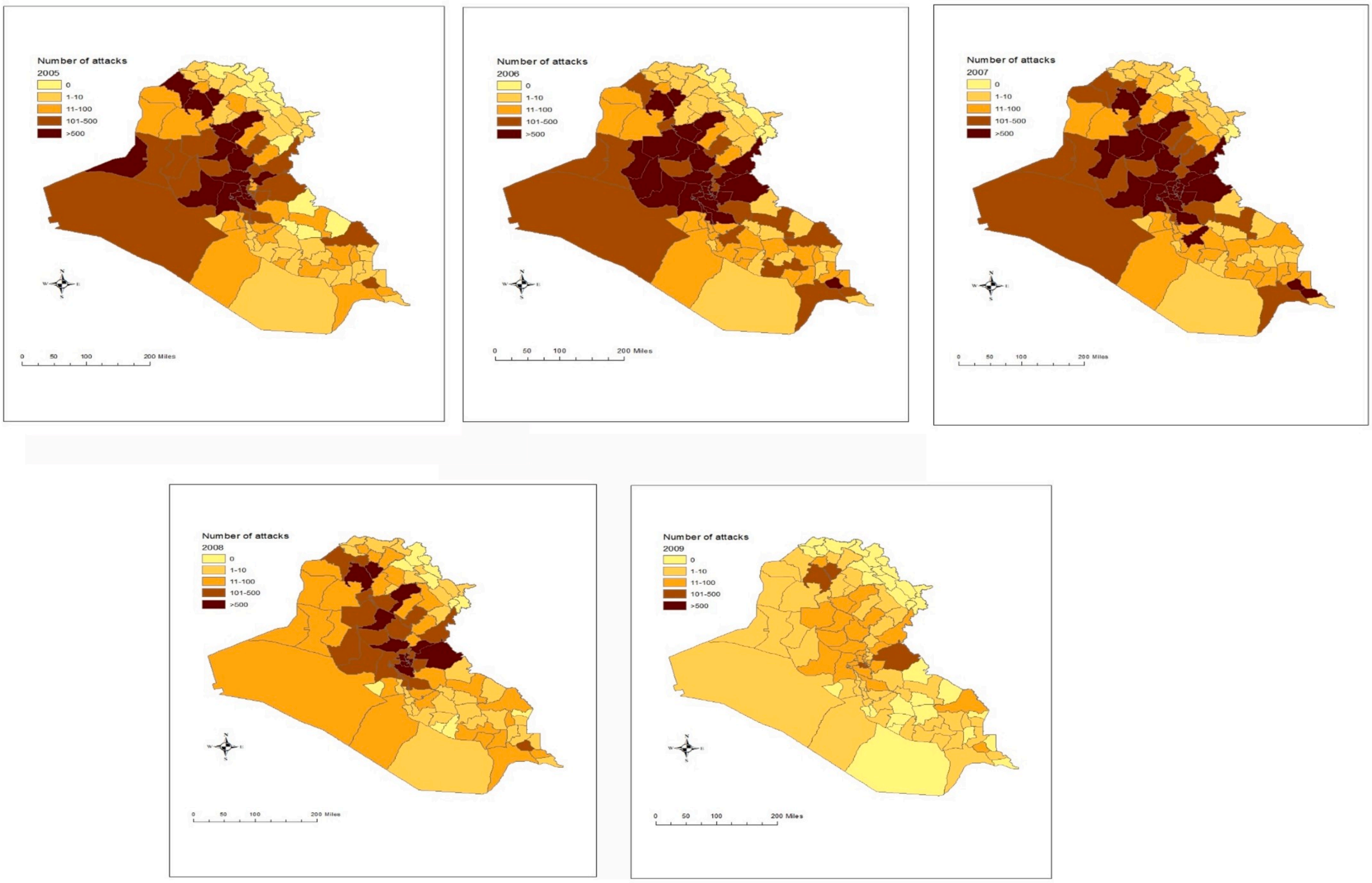

Fig. 2. Variation in the total number of attack incidents across time and districts in Iraq.
Source: Authors' analysis of data from the ESOC project.
Note: The figures show the number of attack incidents (total) for each district between 2005 and 2009.

example, stunted children are more likely to have mothers with no education, live in rural areas, and have no access to clean drinking water than non-stunted children. More importantly, based on their district, the stunted children have been exposed to higher numbers of attack incidents than non-stunted children.

To provide further descriptive information on the distribution of attacks across geographic area and over time, we show a series of maps indicating the total number of attacks by district for each year between 2005 and 2009 in Fig. 2.[11] Nationwide, 28,505 attacks were recorded in 2005, 60,284 in 2006, 66,284 in 2007, 22,424 in 2008 and 1714 during the first two months of 2009. The data underlying these maps are available from the ESOC project website (https://esoc.princeton.edu/).

4.2. Main results

We now turn to results obtained from estimating the relationship between height-for-age z-scores and cumulative violence, accounting for potential confounders and trends. On average, exposure to one additional incident of population-weighted violence is associated with a statistically significant reduction in height-for-age z-scores between 0.006 and 0.019 standard deviations, depending on the measure of violence used (Table 2). The associations with IED and direct fire incidents were largest.

These seemingly small magnitudes, however, mask large differences in the impact on children across the full distribution of cumulative attack incidents. Using the coefficients, we calculate the change in the height-for-age z-scores for children when they are exposed to the highest cumulative number of attacks—based on their district of residence—by type relative to the lowest amount, which is zero attacks for each type. For reference, the highest number of incidents were: 87 per 1000 population for total number of attacks, 78 for non-criminal attacks, 46 for IED incidents, and 30 for direct weapon fire incidents. Based on our estimates, children exposed to the maximum number of attack incidents experience a 0.51 standard deviation reduction in height-for-age z-score relative to children who are exposed to no incidents. The corresponding values for total number of attack incidents excluding criminal attacks, total number of IED incidents, and total number of direct fire incidents are 0.53, 0.50, and 0.57 standard deviations, respectively. Taken together, these findings suggest that each type of attack can have detrimental impacts on child nutrition in Iraq.

Among the covariates that are statistically significant, the signs are in the expected directions based on the existing literature on the determinants of stunting (Akombi et al., 2017; Keino, Plasqui, Ettyang, & Van Den Borne, 2014). For example, children of more educated mothers have higher height-for-age z-scores than children of less educated mothers. Likewise, children in richer households have higher

[11] Recall that the oldest child in our sample is born in February 2009 and exposed to violence while in utero from June 2005 (the month of conception). Therefore, we show the maps for 2005 in addition to 2006 to 2009, when the children in our sample were born.

Table 2
Multivariate regression results for the effect of violence on height-for-age z-scores.

Independent variable →	Measure of violence			
	All attack incidents	All attacks (excluding criminal incidents)	IED incidents	Direct fire incidents
Violence (incidents per 1000 population)	−0.0059** (0.0013)	−0.0068** (0.0015)	−0.0109** (0.0024)	−0.0187** (0.0042)
Child-level indicators				
Gender (boy = 1)	0.0006 (0.0208)	0.0006 (0.0208)	0.0006 (0.0208)	0.0006 (0.0208)
Mother's education				
None (reference)				
Primary	0.1349** (0.0265)	0.1349** (0.0265)	0.1351** (0.0265)	0.1332** (0.0265)
Secondary and above	0.2770** (0.0335)	0.2768** (0.0335)	0.2760** (0.0335)	0.2760** (0.0335)
Household-level indicators				
Household size	−0.0123** (0.0025)	−0.0123** (0.0025)	−0.0124** (0.0025)	−0.0123** (0.0025)
Improved sanitation facility	−0.1284 (0.1255)	−0.1278 (0.1251)	−0.1249 (0.1255)	−0.1316 (0.1251)
Improved water source	0.0869 (0.0477)	0.0869 (0.0478)	0.0862 (0.0476)	0.0881 (0.0480)
Quintiles of wealth index				
Poorest (reference)				
Second	0.0797** (0.0296)	0.0801** (0.0296)	0.0800** (0.0296)	0.0801** (0.0296)
Middle	0.1666** (0.0334)	0.1674** (0.0334)	0.1674** (0.0334)	0.1671** (0.0334)
Fourth	0.2107** (0.0382)	0.2116** (0.0382)	0.2114** (0.0382)	0.2111** (0.0382)
Richest	0.3138** (0.0442)	0.3148** (0.0442)	0.3140** (0.0442)	0.3140** (0.0442)
Urban	0.0136 (0.0245)	0.0128 (0.0245)	0.0122 (0.0246)	0.0151 (0.0245)
Constant	−0.9522** (0.0711)	−0.9525** (0.0711)	−0.9534** (0.0711)	−0.9589** (0.0710)
N	18,199	18,199	18,199	18,199
R-squared	0.02	0.02	0.02	0.02
Minimum exposure	0	0	0	0
Maximum exposure	87.25	78.05	45.96	30.25
Effect of maximum exposure relative to no exposure	0.51	0.53	0.50	0.57

Notes: *p < 0.05, **p < 0.01. This table shows the coefficients and standard errors on the measures of violence from regressions of height-for-age z-scores on measures of violence shown in the top row. Each column represents a separate regression for different measures of violence (cumulative number of incidents per 1000 population). All regressions control for the sex of the child, mother's education, household size, improved sanitation facility, improved drinking water facility, wealth index, and type of residence (urban or rural). All regressions also include birth month and birth year fixed effects and governorate random effects. Standard errors are clustered at the governorate level. The coefficient in the first row can be interpreted as the change in a child's height-for-age z-score due to exposure to one additional incident of violence per 1000 population in the child's district. For each measure of violence, we also report the minimum and the maximum number of attack incidents that the child may have been exposed to based on the child's district. Using the coefficient on the measure of violence, we obtain the effect of maximum exposure relative to no exposure.

Table 3
Multivariate regression results for the effect of violence on height-for-age z-scores, by gender.

Independent variable →	Measure of violence			
	All attack incidents	All attacks (excluding criminal incidents)	IED incidents	Direct fire incidents
PANEL A. Girls				
Violence (incidents per 1000 population)	−0.0059** (0.0018)	−0.0068** (0.0020)	−0.0114** (0.0033)	−0.0176** (0.0058)
Constant	−0.9331** (0.1003)	−0.9329** (0.1003)	−0.9328** (0.1002)	−0.9410** (0.1001)
R-squared	0.02	0.02	0.02	0.02
N	9016	9016	9016	9016
PANEL B. Boys				
Violence (incidents per 1000 population)	−0.0058** (0.0019)	−0.0066** (0.0021)	−0.0103** (0.0035)	−0.0194** (0.0061)
Constant	−0.9760** (0.0985)	−0.9767** (0.0984)	−0.9784** (0.0985)	−0.9816** (0.0982)
R-squared	0.02	0.02	0.02	0.02
N	9183	9183	9183	9183

Notes: *p < 0.05, **p < 0.01. This table shows the coefficients and standard errors on the measures of violence from regressions of height-for-age z-scores on measures of violence shown in the top row, separately for girls (panel A) and boys (panel B). Each column represents a separate regression for different measures of violence (cumulative number of incidents per 1000 population). All regressions control for the sex of the child, mother's education, household size, improved sanitation facility, improved drinking water facility, wealth index, and type of residence (urban or rural). Standard errors are clustered at the governorate level. All regressions also include birth year, calendar month of the birth, and governorate random effects. The coefficient in the first row of each panel can be interpreted as the change in a child's height-for-age z-score due to exposure to one additional incident of violence per 1000 population in the child's district.

height-for-age z-scores than those in poorer households. Finally, children in larger households have lower height-for-age z-scores.

Results from the analyses in which we use the area-weighted measure of cumulative violence are in Appendix Table A1. In each regression, the coefficients on the violence variables are statistically significant. The results show that exposure to one additional incident of violence per square kilometer of area is associated with a reduction in height-for-age z-scores between 0.01 and 0.03 standard deviations depending on the measure of violence used.

We also carried out additional analyses by extending the sample to include children for whom we have violence data only during the period they were in utero. Results in Appendix Table A2 show that the main results also do not change significantly with these additional cases. The coefficients on the measures of exposure to violence are similar in sign, magnitude, and significance to those obtained from the main analytic sample for all four types of attacks.

4.3. Results by gender and geographic region

In Table 3, we show results separately for girls (Panel A) and boys (Panel B). Results reveal that exposure to all measures of violence have negative associations with height-for-age z-scores of girls as well as boys, and the coefficients are similar by gender. The adverse effects of exposure to IED and direct fire incidents are largest across the four measures of attack types. The associations between boys and girls are not statistically different from each other, however (not shown).

We find important heterogeneous associations by geographic region. In Table 4, we show results from regressions of height-for-age z-scores on the measures of exposure to violence, separately for each region. Exposure had a negative and statistically significant association with height-for-age z-scores for all four measures in the northern and the central regions. The only other statistically significant negative association is that of IED incidents in the southern region.

At the bottom of each panel in Table 4, for each region, we also show the mean, minimum, and maximum exposure for each measure of violence, as well as the reduction in height-for-age z-scores when a child is exposed to the maximum amount of violence (within the region) relative to the minimum amount (within the region) based on our regression estimates. This reduction is largest for children in the central region followed by those in the northern region. A child in the central region experiences between 0.58 and 0.66 standard deviations reduction in height-for-age z-scores, while a child experiences between 0.34 and 0.37 standard deviations reduction in the northern region.

5. Discussion

This study is among the first to document the impact of violent conflict on the nutritional status of Iraqi children. We use innovative micro-level data on multiple types of violence and examine their relationship to height-for-age z-scores—a measure of chronic malnutrition—for children ages 23–59 months. Our analyses reveal several noteworthy conclusions. First, our results show that cumulative exposure to violence in a child's district of residence is negatively and significantly associated with child height for each type of attack we evaluate. The associations with IED and direct fire incidents are largest. This is the case whether we use the population-weighted cumulative measure of violence or the alternative area-weighted measure. These findings are consistent with existing research on the conflict-nutrition nexus in other settings; nevertheless, it is not possible to directly compare our results with these earlier studies given different measures of violence used.

Table 4
Multivariate results for the effect of violence on height-for-age z-scores by geographic region.

Independent variable →	Measure of violence			
	All attack incidents	All attacks (excluding criminal incidents)	IED incidents	Direct fire incidents
Panel A. North (N=5551). Mean height-for-age z-score = −1.09				
Violence (incidents per 1000 population)	−0.0039*	−0.0048*	−0.0076*	−0.0124*
	(0.0018)	(0.0020)	(0.0033)	(0.0051)
R-squared	0.03	0.03	0.03	0.03
Mean exposure	8.90	8.00	5.21	2.22
Minimum exposure	0.14	0.11	0.09	0
Maximum exposure	87.25	78.05	45.96	30.25
Reduction in height-for-age due to max. exposure (relative to min. exposure)	0.34	0.37	0.35	0.37
Panel B. Central (N=3996). Mean height-for-age z-score = −1.03				
Violence (incidents per 1000 population)	−0.0148**	−0.0145**	−0.0224**	−0.0573**
	(0.0044)	(0.0047)	(0.0076)	(0.0162)
R-squared	0.03	0.03	0.03	0.03
Mean exposure	2.81	2.41	1.50	0.75
Minimum exposure	0	0	0	0
Maximum exposure	41.78	40.44	25.67	11.53
Reduction in height-for-age due to max. exposure (relative to min. exposure)	0.62	0.60	0.58	0.66
Panel C. South (N=5719). Mean height-for-age z-score = −1.02				
Violence (incidents per 1000 population)	−0.0150	−0.0125	−0.3886**	−0.0262
	(0.0184)	(0.0197)	(0.0905)	(0.0659)
R-squared	0.03	0.03	0.03	0.03
Mean exposure	0.52	0.44	0.15	0.14
Minimum exposure	0	0	0	0
Maximum exposure	6.46	6.15	1.07	1.54
Reduction in height-for-age due to max. exposure (relative to min. exposure)	0.09	0.08	0.41	0.04
*Panel D. Kurdistan (*N = 2933). Mean height-for-age z-score = −0.88				
Violence (incidents per 1000 population)	0.0100	0.0121	0.0167	0.0474
	(0.0132)	(0.0166)	(0.0227)	(0.0633)
R-squared	0.05	0.05	0.05	0.05
Mean exposure	0.63	0.50	0.38	0.10
Minimum exposure	0	0	0	0
Maximum exposure	12.47	10.35	7.64	2.65
Reduction in height-for-age due to max. exposure (relative to min. exposure)	0.12	0.12	0.13	0.13

Notes: *p < 0.05, **p < 0.01. This table shows the coefficients and standard errors on the measure of exposure to violence, separately for each geographic region. Height-for-age z-score is the dependent variable. Each column represents a separate regression for different measures of violence (cumulative number of incidents per 1000 population). Mean exposure is the mean number of incidents per 1000 population. All regressions control for the sex of the child, mother's education, household size, improved sanitation facility, improved drinking water facility, wealth index, and type of residence (urban or rural). They also control for birth year, calendar month of birth, and governorate random effects. The coefficients on the covariates are not shown, but are available on request. The standard errors are clustered at the governorate level. See footnote (1) for the names of governorates included in each region. The coefficient can be interpreted as the change in a child's height-for-age z-score due to exposure to one additional incident of violence per 1000 population in the child's district.

While data limitations preclude us from examining the mechanisms behind these associations, we developed a framework of the proximate determinants of child height to propose potentially important pathways through which conflict could operate (see Fig. 1). It could be the case, for example, that IED incidents—potentially a more unpredictable and indiscriminate form of violence—directly impact several proximate determinants, including maternal stress and child injury. IEDs could also work through other mechanisms to affect the proximate determinants. For example, civilians and supply chains might have difficulty avoiding IED incidents (Hicks et al., 2009), which could curtail food supply or access to health services infrastructure and bring about nutrition deficiencies. Additional data and research are needed to identify the most salient mechanisms at the individual and the community levels linking violence to child nutritional status in Iraq and other conflict zones.

Second, we examine the associations between types of violence and child height for boys and girls and find no gender differences. We initially expected to find that conflict would impact girls' nutritional status more than boys', given existing gender discrimination in Iraq and hypothesizing that conflict situations could exacerbate such discrimination. Indeed, some evidence has found that women and girls face greater sexual and gender-based violence since the Iraqi conflict began (Boghani, 2019; Vilardo & Bittar, 2018). The finding of no gender differences is consistent with a number of previous studies of violent conflict (e.g., Akresh et al., 2012), however. It could be the case that the direct effects of conflict impact boys' and girls' nutritional status equally or that dire circumstances induce parents to struggle for family members' survival regardless of their children's gender. A deeper examination of potential mechanisms, such as differential household decision-making and resource allocation (e.g., differential changes in diets of children by gender), are required to reconcile these findings.

Third, our results reveal that the negative associations between conflict and child height are concentrated in the northern and the central regions, where incidents of violence were higher than in the remaining regions. Although the northern region has been the focus of most of the violence, adverse impacts on child health seem to be greater in the central region, of which Baghdad is the capital.

Our study has several limitations. First, our analysis is based on the sample of children who survived to ages 23–59 months at the time of the MICS survey in 2011. If exposure to violence increases child mortality, the surviving children would be healthier on average, as the most nutritionally deficient children would be more likely to die. In that case, our results would underestimate the effect of exposure to violence on child height.

The second limitation relates to migration, as we estimate exposure to violence based on the district in which the child currently resides, which could differ from the district where the child was conceived, born, and raised. If there is systematic out-migration, our estimates could be biased. For example, if households with less healthy children (i.e., those with lower height-for-age scores) migrate from areas with high violence to areas with low violence, high-violence areas would end up having disproportionately healthier children, thus biasing our estimates downward. Conversely, if households with healthier children emigrate, then high-violence areas would have disproportionately less healthy children, in which case our estimates would be biased upward. Overall, it is difficult to ascertain the net direction of the bias from migration in this case. Unfortunately, the MICS data do not include information on district or place of birth or migration histories to explore these possibilities further.

Third, all the children in the MICS sample were at risk of exposure to the war from conception until the time of the survey in 2011, when the war was still ongoing. This situation precludes an assessment of whether *any* exposure to war affects child nutritional status in Iraq or not as well as an examination of how the end of conflict could impact child health. In addition, we do not have information on violent conflict for the last two years for each child in the MICS sample, given that the conflict data were only collected until February 2009 and the MICS survey was in 2011. This could bias our results. For example, if violent conflict increased in these two intervening years, our results could be underestimated. If conflict decreased in these two years and the negative impact on child height was reversed, our results could be overestimated.

As noted, the ESCO data on violent conflict incidents, while extensive, undercount some types of incidents, such as sectarian violence and some coalition-initiated attacks, which could impact our results. Despite this and other limitations, we consider the current study an important step toward documenting how violent conflict in Iraq relates to child health.

Our findings also have immediate policy and program relevance. The government of Iraq has formulated a strategy to improve nutritional status following recurrent episodes of war, violence, and mass displacement (World Food Programme, 2018). Initiatives include increasing the effectiveness of safety net instruments, promoting agricultural productivity to improve food security, and rehabilitating damaged health care infrastructure. International development organizations have also begun to champion adaptive social protection (ASP) programming, which aims to blend efforts among communities of practice to increase the resilience and adaptability of poor households to conflict, natural disasters, climate change, and economic crises (The World Bank, 2018b). ASP core pillars include identification of groups most vulnerable to specific negative shocks and coordinating swift, scalable institutional responses. Our findings suggest that, in addition to efforts aimed at decreasing violent conflict in Iraq in general, the government and its development partners should focus relief, recovery, and reconstruction efforts in the central and northern regions of the country. Future research into the mechanism linking conflict to child health will provide more information on which specific issues, such as food insecurity or infrastructure collapse, should be prioritized.

Ethics approval

Ethics approval was not required for this paper because it uses publicly-available de-identified data. Data on violence are from the Empirical Study of Conflict (ESOC) project (https://esoc.princeton.edu/). The remaining data are from the Multiple Indicator Cluster Survey (MICS) for Iraq (http://mics.unicef.org/).

Declaration of competing interest

None.

Appendix

Table A1
Multivariate regression results for the effect of violence on height-for-age z-scores using cumulative number of incidents per square kilometer as the measure of exposure to violence.

Independent variable →	Measure of violence			
	All attack incidents	All attacks (excluding criminal incidents)	IED incidents	Direct fire incidents
Violence (incidents per 1000 population)	−0.0101**	−0.0133**	−0.0256**	−0.0339**
	(0.0017)	(0.0027)	(0.0048)	(0.0060)
Child-level indicators				
Gender (boy = 1)	0.0024	0.0024	0.0025	0.0022
	(0.0226)	(0.0226)	(0.0225)	(0.0227)
Mother's education				
None (reference)				
Primary	0.1270**	0.1272**	0.1276**	0.1269**
	(0.0491)	(0.0491)	(0.0491)	(0.0491)
Secondary and above	0.2740**	0.2741**	0.2745**	0.2738**
	(0.0335)	(0.0336)	(0.0336)	(0.0335)
Household-level indicators				
Household size	−0.0122**	−0.0122**	−0.0123**	−0.0122**
	(0.0046)	(0.0046)	(0.0046)	(0.0046)
Improved sanitation facility	−0.1344	−0.1342	−0.1336	−0.1348
	(0.1278)	(0.1278)	(0.1277)	(0.1279)
Improved water source	0.0906	0.0909	0.0909	0.0908
	(0.0475)	(0.0477)	(0.0477)	(0.0476)
Quintiles of wealth index				
Poorest (reference)				
Second	0.0767*	0.0769*	0.0771*	0.0766*
	(0.0372)	(0.0372)	(0.0372)	(0.0372)
Middle	0.1654**	0.1660**	0.1660**	0.1658**
	(0.0405)	(0.0406)	(0.0407)	(0.0405)
Fourth	0.2166**	0.2168**	0.2182**	0.2161**
	(0.0564)	(0.0565)	(0.0571)	(0.0561)
Richest	0.3179**	0.3174**	0.3182**	0.3183**
	(0.0565)	(0.0567)	(0.0569)	(0.0565)
Urban	0.0344	0.0336	0.0336	0.0344
	(0.0472)	(0.0469)	(0.0472)	(0.0471)
Constant	−0.9820**	−0.9829**	−0.9816**	−0.9834**
	(0.1585)	(0.1585)	(0.1585)	(0.1586)
N	18,199	18,199	18,199	18,199
R-squared	0.02	0.02	0.02	0.02

Notes: $*p < 0.05$, $**p < 0.01$. This table shows the coefficients and standard errors on the measures of violence from regressions of height-for-age z-scores on measures of violence shown in the top row. Each column represents a separate regression for different measures of violence (cumulative number of incidents per square km). All regressions control for the sex of the child, mother's education, household size, improved sanitation facility, improved drinking water facility, wealth index, and type of residence (urban or rural). All regressions also include birth year, calendar month of birth and governorate random effects. Standard errors are clustered at the governorate level. The coefficient in the first row can be interpreted as the change in a child's height-for-age z-score due to exposure to one additional incident of violence per 1000 population in the child's district.

Table A2
Multivariate regression results for the effect of violence on height-for-age z-scores extending the sample to include children exposed to violence only in utero.

	Measure of violence			
	All attack incidents	All attacks (excluding criminal incidents)	IED incidents	Direct fire incidents
Violence (incidents per 1000 population)	−0.0059**	−0.0068**	−0.0110**	−0.0185**
	(0.0014)	(0.0016)	(0.0026)	(0.0050)
Child-level indicators				
Gender (boy = 1)	−0.0318	−0.0318	−0.0318	−0.0317
	(0.0208)	(0.0207)	(0.0207)	(0.0208)
Mother's education				
None (reference)				
Primary	0.0992*	0.0991*	0.0994*	0.0976
	(0.0500)	(0.0501)	(0.0498)	(0.0503)
Secondary and above	0.2465**	0.2463**	0.2457**	0.2456**
	(0.0382)	(0.0383)	(0.0381)	(0.0384)
Household-level indicators				
Household size	−0.0168**	−0.0168**	−0.0168**	−0.0167**
	(0.0045)	(0.0045)	(0.0045)	(0.0045)
Improved sanitation facility	−0.1151	−0.1146	−0.1122	−0.1178
	(0.1192)	(0.1189)	(0.1194)	(0.1191)

(continued on next page)

Table A2 (*continued*)

	Measure of violence			
	All attack incidents	All attacks (excluding criminal incidents)	IED incidents	Direct fire incidents
Improved water source	0.0905	0.0905	0.0900	0.0915
	(0.0546)	(0.0546)	(0.0545)	(0.0547)
Quintiles of wealth index				
Poorest (reference)				
Second	0.0744*	0.0746*	0.0746*	0.0746*
	(0.0345)	(0.0345)	(0.0347)	(0.0341)
Middle	0.1609**	0.1615**	0.1615**	0.1612**
	(0.0362)	(0.0361)	(0.0365)	(0.0361)
Fourth	0.2048**	0.2055**	0.2055**	0.2051**
	(0.0566)	(0.0564)	(0.0570)	(0.0564)
Richest	0.3143**	0.3150**	0.3146**	0.3142**
	(0.0594)	(0.0593)	(0.0598)	(0.0590)
Urban	0.0141	0.0134	0.0128	0.0155
	(0.0446)	(0.0444)	(0.0452)	(0.0440)
Constant	−0.8762**	−0.8763**	−0.8766**	−0.8833**
	(0.1293)	(0.1305)	(0.1320)	(0.1282)
N	22,933	22,933	22,933	22,933
R-squared	0.0184	0.0185	0.0184	0.0184

Notes: $^*p < 0.05$, $^{**}p < 0.01$. This table shows the coefficients and standard errors on the measures of violence from regressions of height-for-age z-scores on measures of violence shown in the top row. The sample includes children born between March 2009 and November 2009 (i.e., the children for whom exposure to violence data are available only during the period they were in utero). Each column represents a separate regression for different measures of violence (cumulative number of incidents per 1000 population). All regressions control for the sex of the child, mother's education, household size, improved sanitation facility, improved drinking water facility, wealth index, and type of residence (urban or rural). All regressions also include birth month and birth year fixed effects and governorate random effects. Standard errors are clustered at the governorate level. The coefficient in the first row can be interpreted as the change in a child's height-for-age z-score due to exposure to one additional incident of violence per 1000 population in the child's district.

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