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ABSTRACT

War represents one of the gravest threats to the right to health. A range of international human rights covenants have enumerated the rights of both adults and children to lead full healthy lives, free from the dangers of war. Yet we know remarkably little about how war systematically affects children's rights to health. We have limited knowledge about if different types of conflict—major interstate and major civil wars—have similar or different consequences for children's health. This article examines the immediate and cumulative links of major interstate and major civil wars with infant mortality rates, a key measure of children's health. The article employs generalized least squares regression with two-way fixed effects over the 1950–2007 period. The core results indicate that major civil and major interstate wars substantively violate children's and infants' rights to health. States that spent the most amount of time involved in major interstate wars were associated with the worst overall increases in infant mortality rates.

Background

On March 9, 2022, a maternity hospital was destroyed by Russian air strikes in the besieged Ukrainian city of Mariupol. According to Ukrainian President Volodymyr Zelensky, reports indicated that "[w]omen, newborns and medical staff were killed" (Ward 2022).

One of the medical professionals involved in coordinating the distribution of supplies across the country, Dr. Oleksandra Shcherbet, confirmed the events: "A lot of women, newborns and medical staff were killed—this has to be stopped, it's awful" (Ward 2022).

Unfortunately, the attack on the maternity hospital was not an isolated incident. In a statement to the UN Security Council, Dr. Tedros Adhanom Ghebreyesus, the director general of the World Health Organization (WHO), described how, as of March 17, 2022, only three weeks into the war in Ukraine, WHO had identified 43 attacks on healthcare facilities across the country (WHO 2022). He also described the immediate and longer-term consequences of this destruction. The immediate effects of the "widespread destruction of infrastructure, including health facilities" would lead to a "severe disruption to health services and access to basic commodities."

The director also pointed to the longer-term consequences of the conflict when he stated, "The war in Ukraine is having devastating consequences for the health of Ukraine's people; consequences that will reverberate for years or decades to come" (WHO 2022).

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This stark reminder from the Ukrainian conflict indicates that war represents one of the gravest threats to this fundamental right.

Before the most recent tragic events in Ukraine, in December 2017, on International Human Rights Day, Ghebreyesus noted that, 70 years ago, the organization adopted language into its constitution that the "enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition" (Ghebreyesus 2017).

Although Ghebreyesus did not distinguish among the ages of people who have a fundamental right to health, children and infants have these rights enumerated in the Convention of the Rights of the Child (CRC; United Nations 1989). The CRC considers children to have the same general rights as adults, with rights and responsibilities appropriate for their age. Although the CRC recognizes the fundamental human dignity of children and that the basic quality of life should be the right of all children, it is the responsibility of parents and then the state to ensure the welfare of the child (United Nations 1989).

The rights of both adults and children to lead full healthy lives, free from the dangers of war to their well-being, are also contained in other international human rights covenants, including the International Covenant on Civil and Political Rights and the International Covenant on Economic and Social Rights (United Nations 1966a, 1966b).

Researchers in public health have examined the role of international human rights treaties and the promotion of domestic human rights across a range of population health outcomes, including infant and child mortality (e.g., Akgüngör et al. 2020; Palmer et al. 2009; Reinbold 2019; Tait et al. 2020), but only some have sought to include controls for the impact of war on these outcomes (e.g., Reinbold 2019). The focus of this article is the public health consequences of war, an area of burgeoning systematic research primarily in political science and sociology. It informs us about the effects of conflict across a number of different areas of public health, including the ability of people to lead healthy lives (Ghobarah et al. 2003), adult mortality (Li and Wen 2005), the frequency of different diseases (Iqbal 2006; Iqbal and Zorn 2010), and life expectancies (Carlton-Ford and Boop 2010; Hoddie and Smith 2009).

Despite the valuable knowledge generated by existing research, we still know little about the systematic public health consequences of war[1] on the rights of infants and children to life and survival beyond specific conflicts (Guha-Sapir et al. 2018; Ibrahim et al. 2003), particular countries (Lee et al. 2006), or regions (Davis and Kuritsky 2002, Lee et al. 2006).[2] We also know little about whether different types of conflict—major interstate and major civil wars[3]—have similar or different consequences for protecting children's rights to health. These gaps in the literature provide the foundation for this research.

This article makes two contributions to the literature. It is the first to systematically examine the global association of both major interstate and major civil war on the rights of children to health since World War II. The research uses a key indicator of infant health: the infant mortality rate (IMR). Major interstate and major civil wars are defined as those with at least 1,000 annual battle deaths and follow the correlates of war (COW) criteria delineated in the next section (Gleditsch 2004; Gleditsch et al. 2002; Small and Singer 1982). The availability of an infant mortality rates data-set for all states (Abouharb and Kimball 2007), updated to cover the 1950–2007 period, permits such an examination. Web Appendix A describes all the country years in the dataset.

Another novel aspect of this work stems from the examination of both the short-term and cumulative consequences of major interstate and major civil wars on IMRs over this entire period (Li and Wen 2005). The short-term effects describe the association between a state experiencing an incidence of major civil war or major interstate war in a given year and the infant mortality rate in the subsequent year. The cumulative effects describe infant mortality rates in war-torn societies. In particular, they describe the association between states that have spent more time involved in major interstate or major civil wars and infant mortality rates.

The existing research I discuss below indicates pathways that could link different aspects of conflict to higher infant mortality rates. In this article, I seek to establish if there is any systematic association between different conflict types and higher levels of infant mortality rates. I encourage future research to assess the relative impacts of these different pathways from conflict to higher IMRs, which is beyond the scope of this work.

The existing research provides various arguments linking conflict to higher levels of mortality. Conflict can raise mortality rates directly, as a result of the fighting itself. Conflict can also increase mortality through a variety of indirect effects (Ghobarah et al. 2003, 2004; Iqbal 2006). Conflict worsens many public health outcomes through heightened disease exposure, due to resource shortages and damage to infrastructure (Iqbal and Zorn 2010). War makes travel to seek assistance from public health professionals and access to hospital and clinics treacherous; related evidence from natural disasters indicates that lack of access to medical care is a key factor increasing mortality rates (Kishore et al. 2018).

When war limits government revenue, the state may cut spending on public health (Li and Wen 2005). Governments involved in conflict may divert spending from public health and social protection into spending on weapons and armaments. Conflict can also damage health facilities. Infectious diseases, such as tuberculosis and respiratory infections, spread significantly during civil wars (Ghobarah et al. 2003). These diseases often occur across all age groups, resulting in higher infant and adult mortality rates (Ghobarah et al. 2003).

Some research has highlighted the disproportionately negative effect of war on the life expectancies of women and girls (Plümper and Neumayer 2006). Conflict can also have other public health impacts, which may increase IMRs by worsening social cohesion and increasing the number psychological problems faced by citizens who may be less able to look after their children (Hoddie and Smith 2009; Iqbal 2006).

The cumulative destruction of state infrastructure and the institutions that promote and protect citizens health and well-being means public health outcomes worsen long after the fighting itself stops (Ghobarah et al. 2003, 2004; Iqbal 2006). The cumulative effects of conflict may worsen IMRs even after hostilities end.

This research applies the mechanisms highlighted in the broader public health literature about the short-term and cumulative effects of conflict to the narrower issue of infant mortality. Given previous research, I expect both major civil and major interstate wars to increase infant mortality rates. There is good reason to expect that wars have a short-term effect on infant mortality through the civilian casualties sustained in the conflict. I expect the cumulative effects of war to raise IMRs more than the short-term consequences because of the additional indirect effects discussed earlier.[4]

To be sure, there may be differences in how governments approach healthcare systems that vary between interstate and civil wars. During interstate wars governments have a strong incentive to try and protect their healthcare systems not only to keep their populations healthy but also to help troops get back to the front as quickly as possible. In these cases, governments may try to protect their facilities from destruction. If conflict damages these facilities governments have good reason to repair them speedily, if at all possible, to maintain their war fighting capacity and the morale of their civil population. The example from Ukraine suggests that the widespread destruction of its health system due to the Russian invasion means that it will be very difficult for the Ukrainian government to rebuild these facilities in the near future.

In contrast, some governments in civil wars may intentionally damage and destroy their own healthcare systems for a number of different reasons.

Governments may target their own hospitals and clinics if they believe rebel fighters use these facilities as protective cover. When governments target healthcare systems, they restrict rebel fighters' ability to receive medical assistance. Governments may also damage and destroy their own healthcare infrastructure as part of a strategy designed to break the will of civilian populations who might be sympathetic to rebel demands and force them to acquiesce to government pressure.

For example, the Syrian government, as part of its strategy during the civil war that began in 2011, undertook deliberate "large-scale aerial bombing" of its own healthcare facilities and healthcare workers located in opposition-controlled areas (Fouad et al. 2017). The government and its allies were responsible for 92 percent of healthcare worker deaths in the conflict (Fouad et al. 2017).

Similarly, a coalition of medical charities, the Union of Medical Care and Relief Organizations, reported that 10 hospitals in rebel-held areas of Syria had been targeted by joint Syrian regime and Russian air strikes or artillery attacks during a 10-day period in late 2017 to early 2018, with reportedly dozens of civilians, including children, killed in the air strikes (Katerji 2018).

The vignette from Syria highlights a broader pattern of governments targeting their own healthcare systems and healthcare workers in civil wars ranging from South Sudan and Afghanistan to the Central African Republic (Humanitarian Outcomes 2018). The examples indicate that, at least in some cases, governments may differ in their approaches toward the protection or destruction of their own healthcare systems, depending on if they are involved in interstate or civil war.

The observational nature of the data available to assess these arguments leads me to conservative hypothesis testing: assessing associations between war and infant mortality rates. I label H1 and H1a short-term association hypotheses, which examine the link between war and infant mortality in the following year. H2 and H2a are cumulative association hypotheses and examine the link between progressively more war-torn societies and infant mortality rates.

H1: Major civil wars are associated with higher infant mortality rates.

H1a: Major interstate wars are associated with higher infant mortality rates.

H2: Major civil wars are cumulatively associated with higher infant mortality rates.

H2a: Major interstate wars are cumulatively associated with higher infant mortality rates.

If governments better protect their healthcare systems during interstate war compared to civil war, then we would expect interstate wars to have a smaller negative effect on IMRs compared to civil wars. I assess this possibility by comparing the substantive consequences of interstate and civil wars on infant mortality rates.

Research design

The research design examines the association of major civil and major interstate war and infant mortality rates. The temporal domain of the model spans the 1950–2007 period. I lag all the independent variables one year, except for the conflict history variables, which I lag two years, following the approach used by Li and Wen (2005). The unit of analysis is the country year, and the data-set includes all states using the COW framework.[5] The COW uses three key criteria to identify states. For the period of my study, a state must be "a member of the United Nations … or have population greater than 500,000 and receive diplomatic missions from two major powers" (Correlates of War Project 2016, 5).[6] Each table assesses the short-term and cumulative association of conflict on IMRs described as the short-term association models and the cumulative association models. The analysis examines major interstate war and major civil wars. The threshold for both in the international relations literature is a minimum of 1,000 annual battle deaths (Sarkees et al., 2003), which I describe below.

Table 1. Operationalisation of infant mortality variables.

	Short-term association exp(b)			Cumulative association exp(b)			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Incidence of major civil war$_{t-1}$	1.056**		1.054**				1.074***
	(.019)		(.018)				(.022)
Incidence of major interstate war$_{t-1}$		1.107***	1.105***				1.195***
		(.024)	(.024)				(.034)
Major civil war conflict history$_{t-2}$				1.001		1.001	1.001*
				(.001)		(.001)	(.000)
Major interstate war conflict history$_{t-2}$					1.004	1.005*	1.009***
					(.002)	(.002)	(.002)
Controls							
Ratified CRC$_{t-1}$	1.088***	1.087***	1.091***	1.081**	1.077**	1.078**	1.080**
	(.025)	(.025)	(.026)	(.027)	(.025)	(.027)	(.027)
Population change$_{t-1}$	−.999	−.997	−.999	−.996	−.996	−.995	−.996
	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)
Level of development$_{t-1}$	−.838***	−.846***	−.844***	−.860***	−.849***	−.864***	−.869***
	(.011)	(.011)	(.011)	(.011)	(.011)	(.011)	(.011)
Level of democracy-autocracy$_{t-1}$	−.996**	−.997*	−.998*	−.998	−.998	−.998	−.999
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Level of educational enrollment$_{t-1}$	−.999***	−.999***	−.999***	−.999***	−.999***	−.999***	−.999***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Tropical region	1.094	1.145	1.141	1.161	1.177	1.190*	1.257*
	(.085)	(.092)	(.092)	(.095)	(.098)	(.099)	(.113)
Constant	153.447***	132.494***	135.812***	116.026***	126.506***	107.644***	88.049***
	(2.267)	(17.773)	(18.021)	(15.011)	(17.585)	(14.611)	(12.004)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,857	5,793	5,793	5,797	5,797	5,797	5,789

Notes: Coefficients displayed in exponentiated form. Robust standard errors in parentheses $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

Methods

The core models operationalised in Table 1 use generalized least squares (GLS) regression with two-way fixed effects. The availability of a comprehensive data-set of infant mortality rates with excellent coverage (described below) post-World War II provides a good foundation for this method, as there are few missing cases of IMR to bias the results. The GLS models take the following functional form:

$$Y_t = \alpha_0 + \beta_1^* X_{t-1} + \varepsilon_t$$

Here Y_t is the dependent variable, representing the logged annual rate of IMR. $\beta_1^* X_{t-1}$ represents the independent variables—major civil wars and major interstate wars[7]—in their lagged formats and also the control variables in their lagged formats: ratification of the CRC, population change, level of economic development, level of democracy-autocracy, level of educational enrollment, and a dichotomous indicator about whether a country is in a tropical region. Finally, ε_t is the zero mean error terms.

Web Appendix A and Web Appendix B display descriptive statistics, and pairwise correlations of the independent variables. The highest correlation of .75 is between the IMR (which I lag as a control in the error correction model analyses) and the measure of GDP *per capita*. The results from variance inflation factor (VIF) tests also displayed in Web Appendix A show that the highest value of 3.67 was linked to the IMR measure.[8] The VIF test results indicate that multicollinearity is not a concern (Baum 2009).

In Web Appendix C, I use an error correction model to analyze the robustness of my core findings. The error correction model is appropriate where regressors are weakly exogeneous (De Boef and Keele 2008). For example, in this analysis it is possible that infant mortality rates reflect poor governance and are a precursor of conflict. In the Web Appendix, I describe the specification of the model and the debate in the methods literature about its usefulness (Esarey 2016, Grant & Lebo 2016, Keele et al. 2016a, 2016b), and then I present the results from the analysis.

Finally, in Web Appendix D, I use a Heckman selection model. Previous research examining the link between conflict and adult mortality rates has used this approach (Li and Wen 2005). Researchers were concerned that states which experienced more conflict were also more likely to be missing or to underestimate vital registration data, creating problems of selection bias when trying to estimate the link between conflict and adult mortality. Although the IMR data suffers from far fewer missing cases, it remains possible that the data-generation process biases the analysis. The Heckman selection model allows me to assess this concern when examining the link between conflict and infant mortality rates. I next describe the variables used in the analysis.

Dependent variable

The dependent variable is the logged infant mortality rate measured as the number of infant deaths under the age of one, per 1,000 live births. The variable is logged to reduce the impact of outlying cases on the analysis.[9] There is a broad-based focus in the UN system, which places an emphasis on member states collecting accurate, complete, and internationally comparable infant mortality data wherever possible. Since its inception in 1948, WHO has placed an emphasis on improving infant health and having accurate information about these trends to help the organization decide where to focus its assistance to member states (World Health Organization 1958).

WHO also places a priority on the accurate and complete collection of infant mortality data by its member states (World Health Organization 2018), with IMRs highlighted as one of its 100 core health indicators (World Health Organization 2015). A complementary system headed by the UN Interagency Group for Child Mortality Estimation includes representatives from UNICEF, WHO, the World Bank, and the United Nations Population Division and, since 2004, has led with the production of trends in infant mortality rates using a standardized methodology by groups of countries depending on the type and quality of source of data available. The approach is designed to maximize temporal and cross-national comparability of infant mortality data.

The data used in this analysis come from Abouharb and Kimball (2007). They used more than 50 different sources in constructing their data-set. Their data indicate high levels of coding reliability. They reported a 98.7 percent degree of reliability in randomly sampled cases that were checked for accuracy (Abouharb and Kimball 2007, 752). Their data set provides much better coverage of IMRs than any previously available data-set. For the period analyzed in this article, their data provide coverage of 98 percent of all possible country years for the 1950–1999, and 99 percent coverage for the 2000–2002 period based on the COW coding of states (Abouharb and Kimball 2007, 747).

I updated their data set through 2007 using the UN Economic and Social Cultural Organization Annual Yearbooks (UNESCO various years). IMR data has much broader availability than other similar mortality data, such as under-five mortality data. For the 1950–2007 period, a total of 8,207 cases of IMR are available, whereas only 2,605 cases of under-five mortality are available using UNESCO sources. Despite this broader coverage contained in the IMR data, missing cases remain. Even core registration systems, like the recording of mortality rates, become spotty and less reliable during periods of conflict. It may be that those working in healthcare systems where the most violence and destruction occur face the greatest challenges in accurately recording what has happened. The results of the subsequent analysis, then, likely underestimate the effects of war on infant mortality rates.

Independent variables

Major civil war incidence and major interstate war incidence

The independent variables major civil war incidence and major interstate war incidence come from Gleditsch (2004; Gleditsch et al. 2002).[10] I follow the coding criteria used by the COW to identify both major interstate and major civil wars. An interstate war must have:

> [S]ustained combat involving regular armed forces on both sides and 1,000 battle-related fatalities among all of the system members involved. Any individual member state qualified as a war participant through either of two alternative criteria: a minimum of 100 fatalities or a minimum of 1,000 armed personnel engaged in active combat. (Small and Singer 1982: 56)

A major civil war is defined as any armed conflict that involves: "(1) military action internal to the metropole of the state system member; (2) the active participation of the national government; (3) effective resistance by both sides; and (4) a total of at least 1,000 battle-deaths during each year of the war" (Small and Singer 1982, 60).

I updated the data through 2007 using the PRIO v4 (2009) conflict data set. Countries are coded 1 for each year they are involved in a war (major civil war or major interstate war separately) and 0 otherwise.

Major civil war conflict history and major interstate war conflict history

The independent variables major civil war conflict history and major interstate war conflict history are the percentage of years a country has been involved in major civil war or major interstate war from its advent as an independent state, according to Correlates of War Project (2016) to year (t-2), and follows the approach used by Li and Wen (2005).[11] As the COW data begin after the Congress of Vienna in 1815, the conflict history measures provide an indication of independent states' conflict proneness before the beginning of my analysis in 1950. For example, by 1950 the United States had spent just over 12 percent of its time as an independent state involved in major interstate wars and just over 4.5 percent of its time involved in major civil wars. This information allows me to begin my analysis in 1950 with some indication of these states' conflict histories.

Control variables: Correlates of infant mortality

There is a voluminous literature that has examined the correlates of infant mortality. For the analysis here, it is important to include controls that could plausibly mediate the link between conflict and infant mortality rates.

Previous research has examined if ratification of the CRC reduces child and infant mortality (Akgüngör et al. 2020; Palmer et al. 2009; Reinbold 2019; Tait et al. 2020). Only Tait et al. (2020) found evidence that CRC ratification was associated with lower levels of child mortality. Ratification of the CRC and subsequent monitoring of member states progress on the rights enumerated in the convention by the UN Committee on the Rights of the Child may help to improve children's health through several routes. They include encouraging local health professionals to use these internationally recognized rights domestically to facilitate a minimal core rights approach to help reduce mortality rates (O'Hare et al. 2016).

Research also has noted how the CRC highlights the importance of optimal nutrition for infants, especially during their first two years of life, which reduces mortality rates (Moghaddam et al. 2015). Another stream of research has linked higher levels of wealth to providing additional monies for governments to improve public health and lower IMRs (Caldwell 1986; Flegg 1982; Nyovani et al. 2003; Rodwin and Neuberg 2005). Wealthier states are less likely to become embroiled in major interstate and civil wars because of the increasing opportunity costs of conflict (Fearon and Laitin 2003; Russett and Oneal 2001).

Previous research also has linked democratic regimes to lower IMRs (Bueno De Mesquita et al. 2003; Zweifel and Navia 2000). Democratic regimes are also less likely to become involved in major interstate and civil wars, with arguments that democratic institutions restrain politicians and also reflect the norms of nonviolent conflict resolution (Hegre et al. 2001; Russett and Oneal 2001; Sobek et al. 2006).

Higher levels of education are linked to lower IMRs (Frank and Finch 2004; Hojman 1996; Leppert 1993). The link between more education and lower IMRs often occurs through education's impacts on women who have higher levels of nutrition, lower fertility rates, and higher levels of breast feeding, all of which reduce IMRs (Boehmer and Williamson 1996; Scott and Duncan 1999; Ware 1984). In comparison, individuals who have lower levels of education have been linked to an increased likelihood of violence: They are more likely to join rebel groups and counterinsurgency strategies (Humphreys and Weinstein 2008).

Rapid population growth has been linked to higher IMRs (Fabella and Fabella 2008) due to national and household budget thinning reducing resources available to promote infant health and wellbeing. In the conflict literature, rapid population increases are associated with greater demands for scarce resources and lead some governments to repress groups making those claims, which results in higher levels of conflict at home (Poe et al. 1999), with potential spillovers for more disputes abroad (Gleditsch et al. 2008).

Finally, research has described how tropical regions are associated with higher IMRs (National Academy of Sciences 1962). Tropical regions have been linked to the development of extractive states (Acemoglu et al. 2001), which also have a greater likelihood of becoming involved in conflict both at home and abroad (Gleditsch et al. 2008).

The review yields a set of control variables that captures some of the key findings of previous research while also enabling a broad geographic and temporal examination of the links between major interstate war, major civil war, and infant mortality rates. The controls include ratification of the CRC, level of economic development, level of democracy, level of educational enrollment, population change, and whether the country is in a tropical region. I take a conservative approach and also include year and country fixed effects to limit the influence of country-specific issues or temporal shocks that may be associated with different levels of infant mortality rates.

Finally, to be careful not to overweigh the effects of states' historic conflicts on their current infant mortality rates, I also include "peace years" counters and three cubic splines for each measure of major interstate war and major civil war conflict history. The inclusion of the counters and cubic splines allows for the possibility that the effects of conflict on infant mortality rates decay overtime. The peace years counters sum the annual number of years between major interstate wars and major civil wars, respectively. The inclusion of cubic splines allows for the possibility that there is a nonlinear relationship between the length of time since the previous conflict and subsequent infant mortality rates. Table 2 summarizes the equation variables.

Results

Table 2 displays the short-term and cumulative associations of major civil and major interstate wars with IMRs for the period 1950–2007. I present the exponentiated coefficients in Table 1 to enable direct interpretation of the results. First, I discuss the substantive associations between conflict and infant mortality rates.[12] Next, I discuss the empirical support for Hypotheses 1–2. I conclude with a discussion of the control variables.

The results discuss the mean association between interstate wars, civil wars, and infant mortality rates. Results are significant if they are at or above the 95 percent confidence threshold. Endnotes display the confidence intervals around the predicted values.

Table 2. Association of civil and interstate war on infant mortality 1950–2007, all countries[a]; generalized linear model, two way fixed effects.

Dependent variable	Indicator	Source
Infant mortality rate	Logged number of infant deaths under the age of one per 1000 live births.	(Abouharb and Kimball 2007), updated with (UNESCO various years)
Independent variables		
Incidence major civil war$_{t-1}$	0 = No major civil war, 1 = Major civil war.	(Gleditsch et al. 2002), updated with (UCDP/PRIO 2009)
Incidence major interstate war$_{t-1}$	0 = No major interstate war, 1 = Major interstate war.	
Major civil war conflict history$_{t-2}$	Percentage of years a country has been involved in major civil wars.	Constructed
Major interstate war conflict history$_{t-2}$	Percentage of years a country has been involved in major interstate wars.	Constructed
Control variables		
Ratified CRC	0 = Not ratified, 1 = Ratified	(UNCHR 2018)
Level of development$_{t-1}$	Level of GDP *per capita*	(Heston et al. 2011)
Level of democracy–autocracy$_{t-1}$	Democracy–autocracy	(Marshall and Jaggers 2007)
Level of educational enrollment$_{t-1}$	Total population 000s enrolled in education: sum of those in primary, secondary, and university education.	(Banks 2015)
Population change$_{t-1}$	Percentage annual change in total population.	(Banks 2015)
Tropical region	0 = Country not in tropical region, 1 = Country in tropical region.	(Li and Wen 2005), updated

[a]Cumulative association models include major civil war peace years counters, and three cubic splines and major interstate war peace years counters also with three cubic splines.

The associations of major interstate and major civil war with infant mortality rates, 1950–2007

The first three columns of results in Table 2 examine separately and then together the incidence of major civil war and the incidence of major interstate war with higher infant mortality rates, and indicate a significant association between both types of conflict with higher IMRs in the period post-World War II.

When civil wars flare up, they are, on average, associated with a 5.2 percent infant mortality rate increase in the following year, as displayed in Figure 1 (62.9–66.3).[13] A good example of this comes from 1992 in Tajikistan: When civil war erupted there, the infant mortality rate jumped from 81.8 to 88.4 in the following year, an 8.1 percent increase.

Next, I turn to interstate relations. When conflicts worsen to the severity of a major interstate war, IMRs, on average, worsen by about 10.5 percent, as displayed in Figure 1 (from 63 to 69.6).[14] In specific instances, the jump in IMR can be sizeable. For example, the Iraqi IMR jumped from 67.4 in 1990 to 99.7 in 1991 with the start of the Gulf War—a 47.9 percent increase in the infant mortality rate.

Although these results suggest that major interstate wars have a short-term association with higher IMRs compared to the short-term association of major civil wars, the confidence intervals of these predictions overlap. While the shock of both major civil and major interstate war worsens IMRs, the overlap in predictions counsels caution for inferences concerning if one type of war in the short-term worsens IMRs more than the other.

The results from Table 2 in Columns 4–7 separately and then together assess the cumulative association of major interstate and major civil war with infant mortality rates. In line with previous research (Li and Wen 2005), the final model presented in Column 7 discounts the immediate effects of these different conflict types on infant mortality rates. The cumulative associations strengthen once

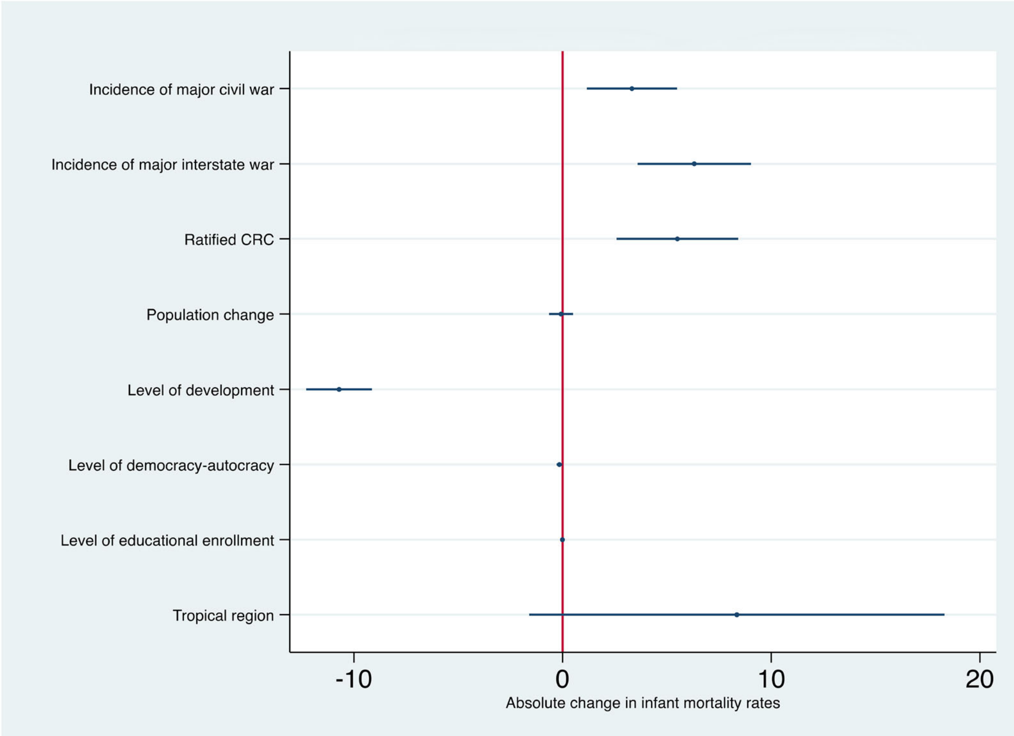

Figure 1. Association of civil and interstate war on changes in infant mortality rates.

we account for the immediate effects of conflict. In Model 7, we see that states that have spent more of their time involved in major civil or interstate wars are associated with higher levels of infant mortality rates, even after discounting for the immediate effects of either type of conflict.

Figure 2 compares states that were not involved in major civil wars with those that spent their entire time as independent states involved in these conflicts.[15] These war-torn societies, on average, endured a 11.5 percent increase in IMRs (from 62.5 to 69.7).[16] To be sure, IMR increases in particular civil wars can be substantial. The Angolan Civil War is a case in point. When the civil war began in 1975, Angola already had a high infant mortality rate of 163.4 deaths per 1,000 live births. By the last year of major civil war in 1994, the infant mortality rate had jumped to 200.3 deaths per 1,000 live births, a 22.6 percent increase in the infant mortality rate.

Finally, the results indicate substantial associations between societies experiencing longer periods of interstate war and higher infant mortality rates. Figure 3 compares states that were not involved in major interstate wars with those that spent almost their entire time as independent states involved in these conflicts, which, on average, endured a 100.7 percent increase in IMRs (from 61 to 122.4).[17] Azerbaijan, which gained independence from the Soviet Union in 1991, was almost immediately embroiled in the Azeri–Armenian war, which ended in 1994. Azerbaijan had an IMR of 62.6 in 1991. By the formal end of the war, the IMR had increased to 75.3 per 1,000. The negative societal reverberations of the war on IMRs continued, and by 1997 it had reached 80.8 per 1,000. In this case, the IMR had increased by 29.1 percent.

Discussion

The results presented in Table 1 provide strong support for the short-term association between Hypotheses 1 and 1a that link the incidence of major interstate war and major civil war to higher

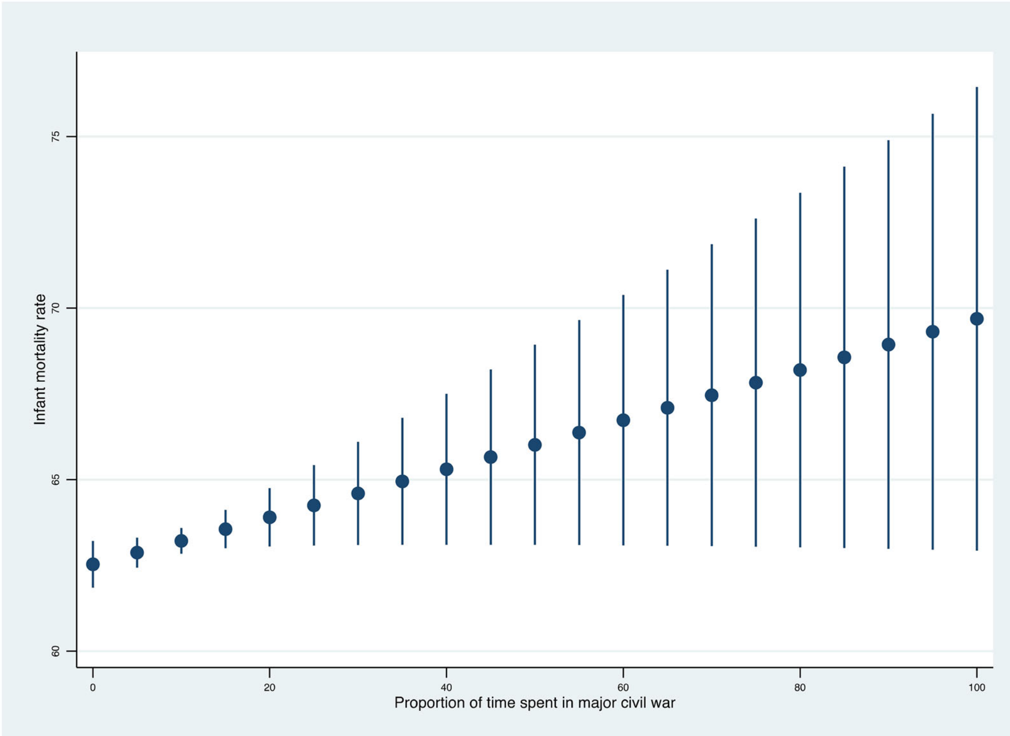

Figure 2. Cumulative association of major civil war on infant mortality rates.

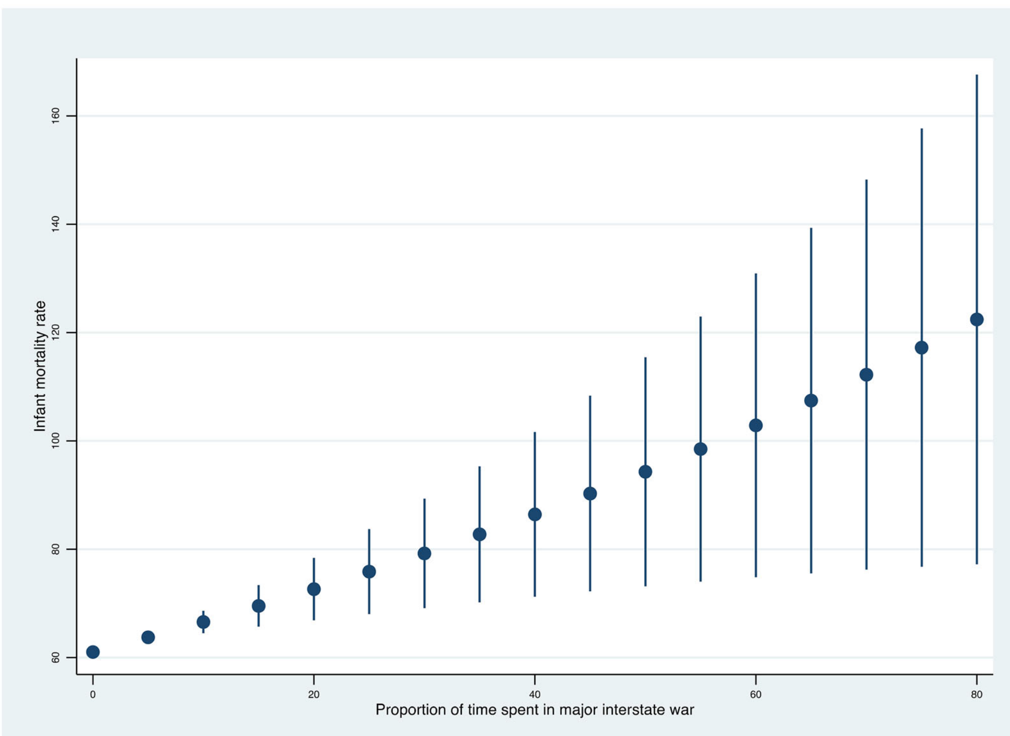

Figure 3. Cumulative association of major interstate war on infant mortality rates.

infant mortality rates, significant across all three models. The results presented in Table 1 also support the cumulative association between Hypotheses 2 and 2a that identify the link between war-torn societies that endure longer period of major civil wars and major interstate wars being linked to higher infant mortality rates.

The findings presented here extend those of previous research, which linked interstate and civil wars to worsened adult mortality rates (Li and Wen 2005). The results suggest that the cumulative effects of major interstate war are associated with larger increases in IMR compared to major civil wars; although these results contrast with my expectations, they are in line with the findings of Li and Wen (2005).

The control variables, when significant, generally behave as expected given previous research. My results support previous arguments about the IMR benefits of economic development (Caldwell 1986; Flegg 1982; Nyovani 2003; Rodwin and Neuberg 2005). Higher levels of GDP *per capita* are significantly associated with lower IMRs across all six models.

There is some evidence for arguments about the benefits of more democratic systems being associated with lower IMRs (Bueno De Mesquita et al. 2003; Zweifel and Navia 2000). The results are significant across three of the six models presented.

The models also provide support for previous research about the role of education reducing IMRs (Frank and Finch 2004; Hojman 1996; Leppert 1993). Higher rates of school enrollment are associated with lower infant mortality rates, significant across all six models presented.

Finally, the results provide very limited evidence that tropical regions are associated with higher infant mortality rates (National Academy of Sciences 1962), significant across only two of the six models presented.

In contrast to my expectations and the findings of previous research (Tait et al. 2020), ratification of the CRC is associated with higher infant mortality rates, significant across all six models presented.

Robustness test

To better ensure the robustness of my results, I use both an error correction model and a Heckman selection model. Error correction models are appropriate where exogeneity is weak. The results from the error correction model presented in Web Appendix C support most of the core findings presented in Table 1. The incidence of major civil war remains significantly associated with higher infant mortality rates. Although the incidence of major interstate war remains associated with higher infant mortality rates, the relationship is no longer significant.

Turning to the cumulative association of war, countries that have spent more of their time in major civil wars remain significantly linked with higher infant mortality rates across both models. In comparison with the core findings presented in Table 1, states that spent more of their time in major interstate wars are now significantly associated with lower infant mortality rates. Since the direction of the major interstate war conflict history findings are sensitive to model specification, we should be cautious about drawing any conclusions concerning this relationship; further analysis is needed.

To be sure there is precedent for the finding. The Human Security Report (2011) made the case that the international community has become more successful in mitigating the consequences of conflict through a variety of different interventions. However, the Human Security Report (2011) provided only descriptive evidence for their argument. They did not subject their claims to rigorous multivariate analysis, nor did they distinguish between the humanitarian consequences of major civil and major interstate wars.

The robustness tests presented here may point to the possibility that international humanitarian interventions have become successful in mitigating some of the negative effects of major interstate wars on infant mortality rates. These results deserve further investigation to directly tease out the link between different types of humanitarian interventions and their ability to ameliorate the negative consequences of war on infant mortality rates.

Finally, Web Appendix D presents a Heckman selection model to address issues of nonrandom data generation that may remain with respect to the production of IMR data. Previous research that examined the link between war and adult mortality used this approach (Li and Wen 2005). Li and Wen's rationale for its use was that states that experienced more conflict were systematically less likely to have data on the outcomes of interest compared to states that experienced fewer of these conflicts, thereby potentially creating a nonrandom sample of available data. The problem they identified was with respect to adult mortality data that had many missing cases. The infant mortality data suffer from far fewer cases of missing data, potentially reducing the concerns about a nonrandom sample of data being available to analyze.

I follow the approach used by Li and Wen (2005) for structuring the selection equation. They recommended including the total number of conflicts and its lag as the predictors, in this case of any IMR data being available. In the analysis this can range from 0 to 2. A 0 indicates that a country experienced neither a major civil war nor major interstate war in that year. A 1 indicates that a country experienced either conflict type in that year, and a 2 indicates that a country experienced both a major civil and a major interstate war in that year.

Perhaps not surprisingly, given the completeness of the IMR data, the total number of conflicts experienced by each state in any given year and its lag did not significantly reduce the likelihood of IMR data availability in any of the models presented. The error terms of model, Rho, were significant in less than half of the models run. Although there is little evidence that conflict randomizes the data generation process, the substantive results presented in Web Appendix D mirror those presented in the core analysis. The immediate association of major civil war and the cumulative association of major interstate war remain significantly associated with higher infant mortality rates; only major civil war conflict history is no longer statistically significant.

Conclusions

This article provides the first systematic attempt to assess the public health consequences of war on the rights of infants to life, measured through the infant mortality rate. The core results link both the short-term association of major civil and major interstate wars as well as the cumulative association of major civil and major interstate wars to higher infant mortality rates. Comparing the short-term impact of different types of conflict on IMR, there is some evidence that major interstate wars are associated with higher IMRs compared to the major civil wars. To be sure, the confidence intervals of these predictions overlap, so further analysis is needed to see if these differences hold.

Comparing the cumulative impact of different types of conflict on IMR, there is evidence that major interstate wars are associated with much higher IMRs compared to major civil wars. The cumulative association of major interstate wars also links to larger increases in IMRs than the short-term associations of either conflict type, although these cumulative findings were sensitive to varying methods of analysis.

There are different ways to build on the findings presented here. The first is to better understand the cumulative associations of major interstate wars with infant mortality rates, given the sensitivity of the findings to model specification. Systematically assessing the public health consequences of different types of international humanitarian interventions may help us better understand the cumulative associations of major interstate wars with infant mortality rates. For example, do some types of third-party interventions better ameliorate the negative public health consequences of conflict in comparison to others? And, do the public health consequences of these interventions vary between interstate and civil wars?

The second and related point is to examine if the Geneva Conventions restrain the strategic choices of states in conflict with each other, and whether there is similar restraint by parties in the conduct of civil wars. What are the public health consequences of these strategic choices?

Finally, future research could try to assess the public health consequences of different types of conflict, but at a much lower level of aggregation, through the use of individual-level data to better understand how and why different types of conflict may have similar or different consequences for public health.

Notes

1. Total death data can only be used to count those individuals who died directly as a function of the fighting (Sarkees 2011). Although the number of battle deaths in war have trended downward especially since World War II (Sarkees 2011), does this directly translate into reductions in mortality of the public? Put simply, we don't know (see Sarkees et al., 2003, for a good discussion).
2. The focus of this article is the public health and human rights consequences of war, the UN Development Programme's (1994) broad human security approach has seven interconnected components that together enumerate the degree of an individual's human security. Three of those factors overlap with the approach taken in this article—in particular, what the UNDP describes as health security (relative freedom from disease and infection), personal security (security from physical violence and threats), and political security (protection of basic human rights and freedoms).
3. Reinbold (2019) is a notable exception that includes both as control variables in his analysis.
4. Murray et al. (2002) is an exception to the consensus that conflict worsens IMRs. They asserted that the IMR consequences of conflict may also depend on whether war leads to new governments that promote broad-based welfare. Under these circumstances, the consequences of conflict may actually lead to lower IMRs in the longer term. This issue is beyond the scope of this work to test, although it does deserve further investigation.
5. Correlates of War Project (2016) State System Membership List, v2016. Retrieved January 31, 2018, from http://correlatesofwar.org.
6. The codebook on page 7 discusses the decisions about when to include Ukraine and Byelorussia, China, and Taiwan into the list of system membership list.
7. Major civil war and major interstate war conflict history measures are lagged two years.
8. The VIF tests were generated using the "collin" command.
9. Logging the value of IMR presents no problems because the original range of the variable is from 2.3 to 355.
10. The underlying framework used to code civil wars stems from Gleditsch et al. (2002). A civil war is defined as one in which armed force is used to promote the parties' general position in the conflict. Any materials can be used as weapons in the conflict. The coding decisions used by Strand et al. (2005) describe the parties that participate in an armed conflict. The government is the party that controls the capital, and the opposition is any nongovernmental group of people who have announced a name for their group and use armed force. The state is either an internationally recognized sovereign government controlling a specified territory or a government not recognized internationally but that controls a specified territory whose sovereignty is not disputed by another internationally recognized sovereign government previously controlling the same territory. The issues over which the parties are fighting range from incompatibilities as stated by the parties over government or territory, such as secession or autonomy, to incompatibilities over the political system, such as the replacement of the central government or a change in its composition.
11. The proportion of time a country has spent in conflict in any given year for each of these variables drops with every additional year it remains an independent nation state and is not in a major interstate war or major civil war respectively. Likewise, when a country becomes involved in either a major interstate war or major civil war, its proportion of time spent in conflict increases and is reflected in a higher value across the different metrics.
12. The predicted values were generated using "margins" command.
13. Confidence intervals 62.9 (62.5–63.3) to 66.3 (64.2–68.4).
14. Confidence intervals 63 (62.6–63.3) to 69.6 (66.7–72.5).
15. Figure 2 is based on Model 7.
16. Confidence intervals 62.5 (61.9–63.2). to 69.7 (62.9–76.4).
17. Confidence intervals 61 (59.9–62.1) to 122.4 (77.2–167.7).

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