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Effect of exposure to conflicts and childhood mortality: Analyses of pooled cross-sectional data from 105 surveys from 52 countries

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Abstract

This study analyses the adverse impact of different types of conflicts on child mortality and its mechanisms across a large group of countries. Our analysis pools data from multiple countries and time-points, to provide robust evidence on the relationship between conflict and child health. Geo-referenced data on different types of conflict are linked with the unit level information from Demographic Health Survey datasets, to construct a unique database of 943139 pre-school age children across 52 developing countries over the period 1993-2018. Our analysis exploits the within-country differences in children's exposure to conflict from in utero to age 5, to estimate its association with mortality outcomes. Our baseline estimate shows the association between conflict exposure and childhood mortality where we found excess mortality in children exposed to conflict. The Cox proportional hazard regression model estimates show that even after controlling for an extensive array of socio-economic and demographic characteristics time and entity-fixed effects, conflict exposure is associated with excess child mortality, across all our measures of conflict. Additional analyses show that probability of dying in the childhood increases with increasing the intensity of exposure to conflict events. Proximate mechanisms explaining excess mortality in children exposed to conflict include poor maternal health outcomes (ANC and Institutional delivery care), child health outcomes (height-for-age and weight-for-age z-scores), and immunization status. These findings are robust across alternative measures of conflict, and sub-samples. Our main findings sustain even after controlling for unobserved heterogeneity and migration history.

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1. Introduction

Childhood mortality is one of the key and sensitive measures of socioeconomic development and a country's state of health (Abouharb & Kimball, 2007). Many of a nation's population characteristics, including life expectancy at birth, are determined by infants' and children's survival rates. Owing to the profound implications of deteriorating child health outcomes, there has been significant engagement with key drivers of such outcomes. Over time researchers have recognised poor sanitation, access to health facilities, nutritional status, environmental impacts such as famine and other natural disasters, conflict and poor healthcare governance as the central contributing factors to infant and child mortality rates (Mosley & Chen, 1984). This study aims to focus on one of these key axes of child mortality outcomes – mother and child's exposure to conflict. This study aims to provide an empirical analysis for studying the linkages between exposure to conflict and the child mortality levels experienced at the global level using a micro-level dataset.

In this regard, growing attention to the conflict as a socio-political determinant of health is gradually gaining traction within the social determinants of health framework. Children, especially, have become the frontline victims of 'new age' mass destructive weaponised wars and conflicts. In 2020, 1.6 billion children (68% of the total children in the world) were living in a conflict-affected country. Among them, one in six (452 million) children are a resident of a conflict zone (Østby et al., 2022). According to the United Nations Inter-Agency Group for Child Mortality Estimation Report (2023), five million children died before attainment of their fifth birthday in 2012. This number is enormous, excruciating, and mostly preventable loss of life. Further, the report published by UNICEF classified 39 countries as fragile and conflict-affected and they record 73 under-five deaths per 1000 live births in 2022 which is three times higher than other countries (UN IGME, 2023). The most recent Israel-Hamas war which has already outpaced those of other conflict zones in the 21st century has killed at least 5000 children in Gaza as of November 2023 and more than 5350 children in Palestinian (UNICEF, 2023). There is a greater chance that these conflict-affected countries may lose the SDG target of 25 or fewer deaths per 1000 live births (UNDESA, 2023).

Although young children are rarely direct combatants in armed conflict, empirical evidence depicts a direct association between conflict-affected kids and child mortality (Gupta et al., 2007; Akresh & de Walque, 2008). Previous researchers have consistently found evidence of lower children vaccinations and maternal health care, higher undernutrition, under-five and infant mortality among children exposed to both civil and armed conflicts (Sato, 2019; Rammohan et al., 2021; Goli et al., 2022; Makinde et al., 2023). Further, these studies interpret that conflicts may result in increased socio-economic disturbances, such as deterioration of infrastructure, disruption of health services, food insecurity, poor sanitation, and displacement of populations, particularly infants and children are more susceptible to these shocks. The evidence also suggests that the impact of armed conflict on child mortality is caused by conflict-induced poverty, malnutrition, communicable diseases, disruption in health facilities, critical care components of health systems or other infrastructure, and destruction of transportation networks (Masset, 2022). These vulnerable conditions make children more prone to untimely death in conflict affected countries (Ali & Adan, 2013).

While previous research has established a link between the conflict and excess child mortality, these studies are largely based on single-country analysis and are also specific to war. Therefore, it

becomes difficult to establish that to what extent conflict matters to child mortality at a global scale. In particular, the impact of conflict on child mortality is homogeneous across the countries (Rammohan et al., 2021; Goli et al., 2022). For instance, the Global Burden of Disease estimates that conflicts caused 0.4% of under-5 deaths in Africa since 1994, raising questions about the role of conflict in the global epidemiology of child mortality (Akresh & de Walque, 2008; Bundervoet et al., 2009; Minoiu & Shemyakina, 2014). Under such prevailing uncertainty, this study aims to provide a systematic micro-level empirical analysis of the links between conflict exposure and child mortality, in a large sample of multi-countries.

To the best of our knowledge, no previous study has investigated the association between conflict and child mortality using a pooled sample from a large group of countries over a long period of 2003-2020. Precisely, our paper addresses this research gap by empirically analysing the effect of conflict exposure status (5 years prior to the conception year) on U5MR, using a pooled sample of 943,139 from 58 countries over the period of 2003-2020. We have built a comprehensive database by merging two data sources: The Upasala Conflict Data Program's (UGDP) Georeferenced Event Dataset and the Demographic Health Survey. Specifically, we merge data (from UGDP) on conflicts using consistent measures for all countries in the sample, with household and mother-level data on birth histories and household-level socioeconomic and demographic characteristics from the DHS dataset. This allows us to investigate whether conflict-exposed children are more susceptible to untimely death using an array of conflict measures that distinguish between the incidence and intensity of the conflict. To showcase the overall scenario as conflict is no longer limited to certain countries and regions, world-level data is also analysed as a baseline drawing on several macro-level data sources. Moreover, we complement this analysis by focusing on two sub-sample analyses for Africa and Asian continents, both contributing the largest share of the child population to the world and have a long and consistent history of armed and civil conflict making them lead in U5MR due to conflict.

Finally, the study also examines the several mechanisms through which conflict influences child mortality using Mosley and Chen's analytical framework on child mortality (Mosley & Chen, 1984). The study investigates those mechanisms by which the socioeconomic determinants operate to produce the observed child mortality differentials specifically among children exposed to conflict. The determinants are selected by considering Mosley and Chen's five broad categories of proximate determinants of child mortality namely, socio-economic factors, environmental contamination, maternal factors, nutrient deficiency, injury, and personal illness control. The findings advance that childhood mortality by classified according to conflict exposure status shows a significant increase for those who are exposed to conflict at the global level and both in Asia and Africa. The results are consistent across several robustness checks. Poor maternal health care, low vaccination coverage, and undernutrition among children are identified as some key pathways that leads to excess child mortality and are also highly influenced by exposure to conflicts.

The rest of the paper is organized as follows. First, we review the existing literature and discuss the hypotheses on conflict-child mortality links. Next, we describe the data followed by the methods used in our analysis. We then present the empirical findings from our study. Finally, we discuss the conclusions and policy implications of our findings.

2. Conflict and Child Mortality: Prevailing hypotheses

2.1 Conflict influence on Child Mortality through Socio-Economic and Environmental factors

The Stockholm Declaration stated that all persons can enjoy their human rights only in an environment that promotes their human dignity and well-being (Handl, 2012). Many children living in lethal war zones are already at risk of climate change and facing unprecedented levels of hunger as well. Areas experiencing land degradation are 24% more likely to experience conflicts, and conflicts that last 23% longer, have an even greater impact on affected children and their families (World Vision, 2023). Consequently, conflicts also produce an adverse impact on the environment. Nuclear weapons, small arms, fires, destruction of forests, water pollution, and air pollution are all methods of warfare that destroy the environment with a severe impact on children (Olusegun, 2021). Unavailability of natural resources can be both a cause and effect of conflict and migration. For instance, water-related crises have been ranked as the biggest concern for societal risks and also prime influencers for children's deaths. Children under five living in conflict areas are 20 times more likely to die from diseases related to unsafe WASH systems than from violence (UNICEF, 2023). Unhealthy sanitation including unsafe drinking water, no toilet facility and less hygiene creates conditions which are conducive for the spread of infectious diseases. And, children are even more susceptible to it if they are exposed to any type of conflict. Diarrhoeal disease, the fourth leading cause of death among children under-five globally, is primarily caused by use of unsafe drinking water and poor sanitation and hygiene. Many nations that had not seen cholera outbreaks for a long time have started witnessing such outbreaks since 2021. In 2022, nearly thirty countries—consisting of Haiti, Lebanon, Malawi, and the Syrian Arab Republic—saw a record number of significant cholera outbreaks caused by droughts, floods, and conflict (UNICEF, 2023).

Armed conflict is a major concern from population development perspective. It has profound socio-economic and developmental impacts on populations, that range far beyond direct deaths and injuries. In countries experiencing land degradation and conflict, the most vulnerable people struggling to get adequate meals as the crisis destroys livelihoods and incomes, drives up food prices, and increases child malnutrition. Also, conflict-led fear and security concerns, availability of transport facilities, wage loss, and injury or death of family members or neighbours also influence health-seeking behaviour. A new analysis conducted for international humanitarian NGO World Vision highlights how land degradation and conflict are driving the hunger crisis in 23 of the worst-affected countries in the world. Also, conflict-led fear and security concerns, availability of transports facilities, wage loss and injury or death of family members or neighbours also influence health-seeking behaviour (Tyndall et al., 2020; Das et al., 2020; Ataullahjan et al., 2020; Ahmed et al., 2020).

2.2 Conflict influence on Child Mortality through Women's status and Violence against them

Women and girls more often bear the indirect consequences of conflicts. More than 600 million women and girls lived in conflict-affected countries in 2022, a 50 percent increase since 2017 (UN Women, 2023). During conflicts, marriage has been used as a 'coping or protective mechanism' to save young girls from physical and sexual exploitation, and also for consumption smoothing to sustain the household economy in difficult times. Girl-child marriages in conflict settings is one of the gender-based discrimination committed as a 'protective' measure against sexual violence or threat to life and as a mechanism to cope with poverty during the crisis. Child marriage is not only a public health issue but a developmental concern, more so in conflict settings (Singh et al., 2022).

2.3 Conflict influence on Child Mortality through Maternal and Child Health Care Factors

Previous research, in particular from the BRANCH consortium case studies has demonstrated that conflict impacts negatively on maternal and child health, child birth weight, and immunization rates (Bhutta et al., 2019). Deterioration in maternal health or healthcare accessibility directly influences the child's well-being and survival. Worldwide, 210 million women become pregnant each year, giving birth to roughly 140 million newborns. Furthermore, pregnant women experiencing armed conflicts tend to face higher risks of pregnancy-related deaths and are more likely to give birth to unhealthy babies resulting in death (Quintana-Domeque & Ródenas-Serrano, 2017; Kotsadam & Østby, 2019; Brown, 2020). Conflict affects mothers both physically and mentally leading to unfavorable birth outcomes such as low birth weight and premature babies (Brown, 2020; Mansour & Rees, 2012). On the other hand, exposure to armed conflicts during pregnancy reduces women's utilization of prenatal care and delivery care indicated by the decline in the composite indices of prenatal care and delivery care by 6.76% and 6.83% compared to the sample averages, respectively (Nguyen & Le, 2022). Insufficient care during pregnancy and delivery at home, and military checkpoints raise the risk of pregnancy-related morbidity for the mothers and the risk of poor birth outcomes for the babies (Conway & Kutinova, 2006) Disrupted infrastructure of maternal care and loss of caregivers together restrict the 4 times ANC visit recommended by WHO. Price and Bohara found a strong negative correlation between the incidence of conflict-related violence and the number of ANC consultations in Nepal (Price & Bohara, 2013). Similarly, Rammohan and colleagues found a significant negative association between exposure to conflict and the continuum of care services that are crucial for achieving improvement in reproductive, maternal, and child health and nutrition (RMNCHN). Their study further states that by disrupting health infrastructure, mobility of health workers, availability and accessibility of health care provisions, conflict exposure may negatively affect the utilization of care throughout the continuum of health care (Rammohan et al., 2021).

A wide spectrum of literature has been able to capture the gender effect on population health attributed to conflict with higher mortality among women than men implying a greater level of women-centric vulnerability (Ghobarah et al., 2004). Additionally, the increased incidence of sexual violence and rape during conflict also increases rates of maternal morbidity and mortality (Chi, et al., 2015). Relatedly, some studies found a strong negative correlation between the incidence of conflict-related violence and the number of ANC consultations in Nepal (Fatusic et al., 2005; Price & Bohara, 2013).

2.4 Conflict influence on Child Mortality through Nutrient Deficiencies

The two anthropometric measures of height-for-age (HAZ) and weight-for-age (WAZ) are critical measures of child nutrition and reflect nutritional status over different durations. Underweight (weight-for-age) is determined by short-term energy balance and is therefore an indicator of acute undernutrition while stunting (height-for-age) is determined by an inadequate energy balance over time and indicates chronic malnourishment. Child nutrition requires adequate feeding and care practices, sanitation, dietary diversity, nutrient density, and a satisfactory level of short- and long-term health. These are difficult to achieve in a conflict environment, and therefore child anthropometric measures provide an objective assessment of the impact of conflict on child health.

Studies on the relationship between civil war and child HAZ unanimously find a statistically significant and negative relationship between conflict exposure and HAZ. However, the focus of

this literature has been on ongoing armed civil conflicts. These include studies on the impact of civil conflict on HAZ in Ethiopia (Kadir et al., 2019), Burundi (Bundervoet et al., 2009) and Cote d'Ivoire (Minoiu & Shemyakina, 2014). Previous research on the relationship between conflict and child WAZ has generally found a statistically significant, negative relationship between the two variables. Studies from Angola (Arcand et al., 2015), Uganda (Kim, 2019), Nigeria (Ekhator-Mobayode & Abebe, 2019), and Afghanistan (Oskorouchi, 2019) found a statistically significant association between conflict and infant WAZ. In the Afghan context, each additional fatality per 10000 inhabitants during pregnancy caused a 0.20 standard deviation reduction in WAZ (Oskorouchi, 2019), and in Angola (Agadjanian & Prata, 2003) an additional 100 suspected hazard areas within 150 km of the infant led to a reduction in WAZ by 0.40-0.48 standard deviations depending on the dataset used.

2.5 Conflict influence on Child Mortality through Interruption in Personal Illness Control

According to Mosley and Chen's framework (Mosley & Chen, 1984), personal illness control is a preventive measure to avoid disease. It includes immunization, medical treatment, medicine availability, and health infrastructure and technology. Interruption in any of these basic health requirements can affect the children's health status leading to child mortality.

In the context of child health, some of the underlying factors influencing this relationship include poor access to essential medicine, health care, immunization, and basic sanitary services. Conflicts also impact maternal or caregiver mental health, behavioural changes in response to stress (e.g. dietary intake and diversity, smoking, exercise, and alcohol consumption), selective foetus mortality, pre-term deliveries, unsafe or inadequate living conditions, hunger, and chronic insufficient food intake, sustained incorrect feeding practices of babies, frequent infections and diarrheal diseases. Conflicts may also disrupt health infrastructure and cause outbreaks of infectious diseases, disruption in economic activities, wage and income loss, and an increase in violence against women (Bendavid et al., 2021; Grundy & Biggs, 2019; Jawad et al., 2021; Mirzazada et al., 2020).

Immunization is a vital and cost-effective disease prevention and control strategy. Despite the growth in vaccine development and immunization delivery systems globally, children in areas of conflict areas often have inadequate or no access to lifesaving vaccines (UNICEF, 2015). Country case studies from the BRANCH consortium (i.e., Bridging Research & Action in Conflict Settings for the Health of Women and Children) find significant disruptions in immunization coverage of children due to armed and civil conflicts in Angola, Somalia, Yemen, South Sudan, Syria, and Nigeria. A study on the association between armed conflict and vaccination uptake during the Boko Haram insurgency in North Eastern Nigeria found that the odds of a child receiving any vaccination is 47.2 percentage points lower if an armed conflict occurred within 10 km (Sato, 2019).

An assessment from 16 countries finds that the onset of conflict is associated with an unexpected decline in countrywide and sub-national coverage of vaccinations. They attribute this to poor safety, damaged health infrastructure, and exhausted human resources, which led to infrequent outreach services and delays in new vaccine introductions and immunization campaigns (Grundy & Biggs, 2019). Systematic review studies have reported that armed conflicts globally are at an all-time high, and are negatively associated with vaccination coverage (Kadir et al., 2019). Yet the impact of conflict on global immunization goals has not been fully addressed, especially in developing countries where their implications are detrimental. Thus, it critical to examine the

association between violent conflicts and their effect on childhood mortality using a large sample from multiple developing countries using cutting-edge empirical approach.

3. Methods

3.1 Data source

The data for the empirical analyses of this study come from combining two key sources: the data for the predictor variable, the number of conflicts and deaths, are obtained from the Uppsala Conflict Data Program (UCDP)'s Georeferenced Event Dataset version 19.1 (Sundberg & Melander, 2013). The UCDP gives information on the dates, locations, and the number of deaths linked with violent conflict around the world from 1989 to 2018. The UCDP defines a violent event as: "an individual incident of lethal violence occurring at a given time and place" (Högbladh, 2019).

The data on the outcome variable of this study, measures of under-five child mortality, come from the Demographic Health Surveys (DHS) – a collection of nationally representative repeated cross-sectional surveys conducted in over 90 developing countries since 1984. The DHS interviews women of childbearing age (15-49 years) using a standard questionnaire across all countries. It includes detailed questions on the socioeconomic and demographic characteristics of the surveyed women and their households, the birth histories of all children born in the five years before the survey, and information relating to the use of health care services. In this study, we employ data from the DHS conducted from 2003 to 2018 in 58 countries where our variables of interest and conflict information in the UCDP dataset are available.

For the purpose of our analysis, we match conflict data from UCDP to DHS using the names of provinces that are available in both datasets.[1] We define conflict exposure based on the 5 years preceding the conception of a woman's last birth. This approach to defining the reference period is largely based on considerations around the availability of birth histories of children born in the 5 years prior to the interview date in the DHS. The oldest last birth in the sample goes back to 1998, therefore the associated conflict data goes back to 1993, 5 years preceding the conception of the last birth. Thus, we consider conflict occurring in the 58 countries over the period 1993-2018, matching this with the records of individuals observed in the DHS surveys during 2003-2018. We present information on the number of observations available on key variables of Asia, Africa, and the World.

3.2 Key measures

Our main outcome variable is the under-five children mortality rate. For all women who had given birth in the five years before the survey, we used self-reported responses on a range of mortality outcomes and preference questions to construct our dependent variables. For this particular study, we have only focused on the under-five child mortality rate per 1000 live births as the outcome variable.

[1]UCDP's Georeferenced Dataset provides information on the second-older administrative division of conflicts such as districts, municipalities or communes, but this information is missing for nearly one-third of the observed conflicts. 1 Moreover, the sub-provincial locations were not reported consistently over time due to the changes in administrative systems. Our analysis, therefore is conducted at the provincial level.

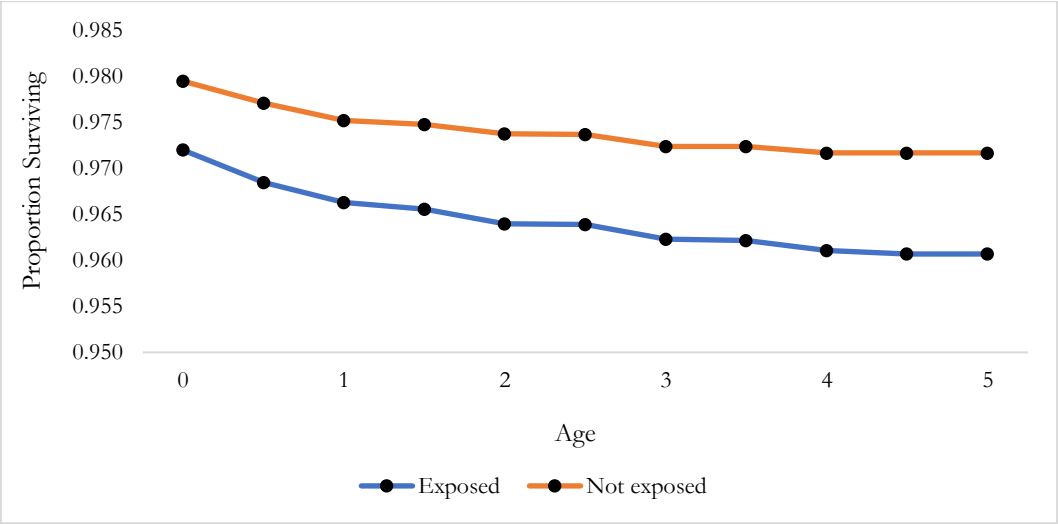
The main explanatory variables in our analysis are measures of lifetime exposure to violent conflicts. These are defined based on violent events that took place within the province of a child's residence throughout the period since their conception to the time of the interview[1]. We exploit the information in the UCDP dataset to construct several key measures of lifetime conflict exposure. To explore whether conflict matters for child mortality outcomes, we start with a binary measure of exposure. This variable takes on 1 if a child has been exposed to at least one violent event of any kind in their lifetime (i.e. since conception to the time observed during the interview) and 0 otherwise which means no exposure to conflict.

Our analysis compares children with similar observable individual, household, and province characteristics. As such we control for variables that are known to influence child stunting, underweight, and immunization status. Table 1 also provides descriptive statistics of all the variables used in the empirical analysis. These include the socio-economic and demographic profile of households (including the age and gender of the household head, household size, access to piped water and flush toilet, rural/urban residence, and wealth quintile, based on the wealth index measure available in DHS generated from data on household asset ownership using principal component analysis), an array of maternal characteristics (education levels, age, age at marriage, height, age at first birth, age at first cohabitation and current use of contraception), and information on children such as their gender, age (and its squared term), birth order, and whether they are part of multiple births.

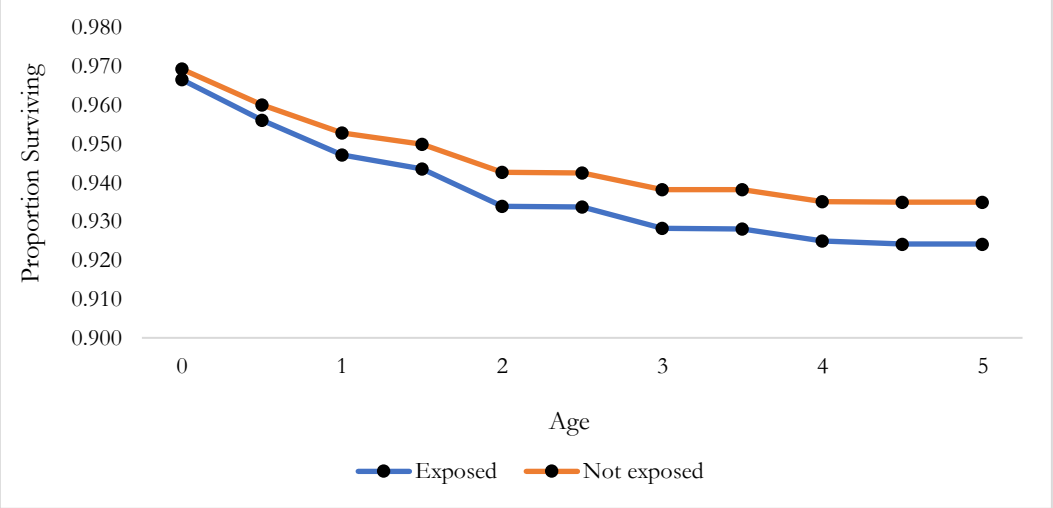
3.3 Descriptive Statistics

The study begins its analyses by looking at the probability of a child surviving from birth to the fifth birthday by the status of exposure to conflict (i.e. exposed and unexposed) for the World, Asia and Africa. Separate analyses for Africa and Asia were conducted to justify two factors: firstly, these two continents have the highest share of children population (0-5 years) and secondly, they ranked at the top in terms of their share in conflict activity. As per PEW report (2020) on conflict trends suggest that Asia is the region with world's highest number of children living in conflict zones counted around 184 million children and Africa had slightly less with 182 million (Østby et al., 2022). Fig 1, suggests that under-five children survival is consistently less among them who are exposed to conflict than those not exposed in Asia, Africa, and the World. These three figures show that Asia has recorded a slightly higher proportion of children surviving than Africa. In the case of Africa, the mortality is higher for three to five-year-old children compared to newborns. The survival gap between conflict-exposed and unexposed children is quite visible where the former are in a disadvantageous state compared to the latter. The gap is wider in Asia than in Africa indicating a greater influence of conflict on child death in Asia rather than Africa.

A. Asia



B. Africa



C. World

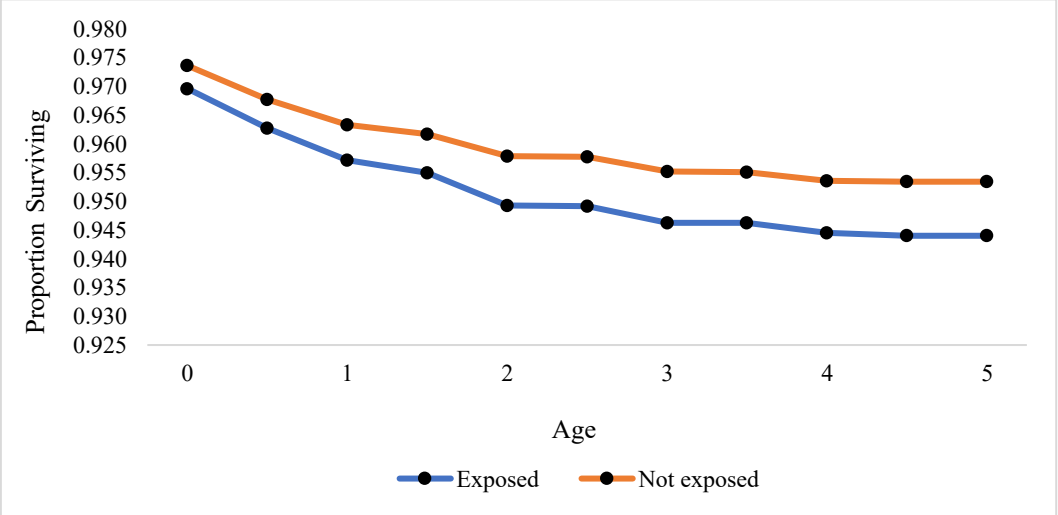


Fig 1: Proportion of Surviving by age and exposure to conflict

In Table 1, we have reported the summary statistics (means and standard deviation) of selected study variables by conflict exposure status 5 years prior to the date of the survey. Based on the literature review, the variables are selected focusing on three major themes: (i) maternal factors including maternal and child care infrastructure (No of ANC, place of delivery, birth space, child's birth order); (ii) household environment (sanitation facility, type of cooking fuel used); (iii) household socioeconomic characteristics (age, educational attainment, working status, details of household head, place of residence, wealth status). The exposure to conflict appears to have significant implication on child and maternal health outcome as well as basic household needs.

The dropout rate in access to maternal and child care is significantly higher among women and children who have been exposed to conflict, relative to those who have not had such exposure. For instance, access to 4 and more ANC visits was high, with 58.6% of women in non-conflict areas. However, it is nearly 11 percentage points lower among women exposed to conflict. We observed similar results in the case of place of delivery where 65% of institutional deliveries were recorded in no conflict exposure compared to 58% in areas exposed to conflict. Furthermore, the child's birth order and mother's age at birth are significantly lower in the 'With Conflict' zone due to the common occurrence of intensive violence, sexual assault, and rape in the conflict chaos leading young girls and mothers to be most vulnerable. In terms of access to basic needs, the major problem among all the conflict-affected people throughout the World is the lack of access to safe drinking water (UNICEF, 2022). This data validates this claim by showing a significant difference in the use of piped water (0.098) between the two groups, ultimately lowering the survival chances of children.

Table 1: Comparison of the sample by conflict exposure status in 5 years prior to the conception year

Background variables	No Conflict (N=427,242) (Conflict=0)		With Conflict (N=515,897) (Conflict=1)		Difference between the two groups
	Mean	Std. Dev.	Mean	Std. Dev.	
Child is alive	0.943	0.192	0.951	0.196	0.008***
4 or more ANC	0.586	0.493	0.47	0.499	0.115***
Place of delivery	0.654	0.476	0.579	0.494	0.075***
Respondent currently working	0.512	0.5	0.451	0.498	0.06***
Birth space >=3 years from last birth	1.52	0.5	1.462	0.499	0.059***
Child's birth order	2.691	1.203	2.59	1.191	0.101***
Father's highest education	1.167	0.969	1.296	1.021	-0.13***
Father with no education	0.268	0.443	0.206	0.405	0.061***
Father completed primary education	0.228	0.419	0.16	0.366	0.068***
Father completed secondary education	0.274	0.446	0.245	0.43	0.029***
Father completed higher secondary education	0.067	0.249	0.084	0.277	-0.017***
Use piped water	0.365	0.481	0.267	0.443	0.098***
Use flush toilet	0.298	0.457	0.302	0.459	-0.005***

Cooking fuel is electricity, LPG, and gas	0.227	0.419	0.203	0.402	0.024***
Mother's age	29.049	6.999	28.326	6.556	0.722***
Mother with no education	0.327	0.469	0.364	0.481	-0.038***
Mother completed primary education	0.287	0.452	0.216	0.412	0.071***
Mother completed secondary education	0.301	0.459	0.333	0.471	-0.032***
Mother completed higher secondary education	0.071	0.256	0.077	0.268	-0.007***
Household head's age	42.673	13.981	42.837	14.153	-0.164***
Household head is male	0.823	0.382	0.866	0.341	-0.043***
Household size	7.298	4.874	6.87	3.737	0.428***
Rural	0.655	0.475	0.693	0.461	-0.037***
Poorest	0.228	0.42	0.243	0.429	-0.015***
Poorer	0.211	0.408	0.217	0.412	-0.006***
Middle	0.205	0.404	0.194	0.395	0.011***
Richer	0.19	0.392	0.177	0.382	0.013***
Richest	0.166	0.371	0.169	0.374	-0.003***
Percentage of households in the Poorest quintile at the provincial level	21.15	14.927	23.186	15.545	-2.036***
Place of residence	1.655	0.475	1.693	0.461	-0.037***

Note: Significance levels *** p<0.01, ** p<0.05, * p<0.1

Next, we take a closer look at how U5MR (per 1000 live births) by conflict exposure status in 5 years prior to the survey yielding different results who are exposed from those 'Not Exposed to Conflict' (Table 2). This time we have provided the data figures for U5MR for Asia, Africa, and the World for capturing regional variation by distinct socioeconomic and demographic conditions. Africa shows a significant difference of 14 deaths among children by exposure to conflict due to less than 4 ANC visits as prescribed by WHO. Under-five mortality due to home delivery is significantly higher in places exposed to conflict in Asia (50), Africa (96), and the world (75). The variables related to the household environment show a similar pattern. The households not using piped water as a consequence of conflict are making their children more susceptible to death. U5MR is 43 per 1000 live births in Asia who are exposed to conflict and not using piped drinking water against 26 per 1000 live births among those who are not exposed to conflict but not using piped water. We observe significant differences in U5MR in all three regions among conflict-exposed and not-exposed households that use no toilet facilities and unsafe cooking fuel. In terms of demographic characteristics, under-five mortality with a history of fathers who have no education are showing significant difference with the exposure to conflict. In Africa, 106 under five mortality per 1000 live births whose fathers are not educated was recorded in conflict-affected areas against 87 deaths whose fathers are not educated and are not exposed to conflict. This similar trend is visible in the case of mother's education also. Conflict can affect an individual's as well as a country's economic status to a greater extent leading to deterioration in health status among children. U5MR is worsening with lowering economic status in all three regions and the difference between the conflict-exposed and not exposed group is highest in the poorest household category. In Asia, U5MR is 20 percentage points higher among the poorest households in conflict-exposed areas, followed by 19 percentage points higher in Africa and the World.

Table 2: Comparison of the U5MR (per 1000 live births) by conflict exposure status in 5 years prior to the conception year

Background Characteristics	Asia			Africa			World		
	Not exposed to Conflict	Exposed to Conflict	Difference (Exposed-Not exposed)	Not exposed to Conflict	Exposed to Conflict	Difference (Exposed-Not exposed)	Not exposed to Conflict	Exposed to Conflict	Difference (Exposed-Not exposed)
ANC: 4 or more	19	25	6***	59	64	4***	41	46	5***
ANC: less than 4	48	50	7***	80	95	14***	65	74	9***
Place of delivery: Institutional	21	31	10***	59	62	4***	42	48	6***
Place of delivery: Home	35	50	14***	87	96	8***	63	75	12***
Birth space from last birth: 3 or more years	24	34	10***	60	64	4***	43	50	7***
Birth space from last birth: less than 3 years	33	46	13***	80	93	13***	58	71	13***
Respondent currently working	32	50	18***	76	81	5***	56	67	11***
Father with no education	50	60	11***	87	106	19***	70	85	15***
Father completed primary education	32	49	17***	65	78	12***	50	65	15***
Father completed secondary education	23	33	10***	55	61	6***	40	48	8***
Father completed higher secondary education	13	22	9***	43	45	2***	29	34	5***
Use piped water: Yes	23	29	6***	49	52	3***	37	41	4***
Use piped water: No	26	43	17***	82	88	5***	56	67	11***
Use flush toilet: Yes	21	27	6***	34	40	6***	28	34	6***
Use flush toilet: No	35	47	12***	78	87	10***	58	69	10***
Cooking fuel is electricity, LPG, and gas: Yes	19	24	5***	41	39	-3***	31	32	1***
Cooking fuel is electricity, LPG, and gas: No	34	45	11***	77	84	8***	57	66	9***
Mother with no education	52	59	7***	86	99	13***	70	81	10***
Mother completed primary education	33	39	7***	68	79	11***	52	61	9***
Mother completed secondary education	22	28	6***	48	56	8***	36	43	7***
Mother completed higher secondary education	12	15	3***	28	34	7***	21	25	5***
Household size: 5 and more	20	33	13***	60	70	10***	42	53	11***
Household size: Less than 5	38	53	15***	94	101	7***	68	79	11***
Household head: Male	26	38	13***	70	80	10***	50	61	11***
Household head: Female	28	40	11***	69	77	9***	50	60	10***
Poorest	35	55	20***	82	101	19***	60	80	19***
Poorer	29	46	17***	80	93	13***	57	71	15***
Middle	25	39	14***	68	82	14***	48	62	14***
Richer	23	27	4***	66	71	5***	46	51	5***
Richest	17	18	1***	51	50	-2***	35	35	0***
Place of residence: Urban	20	26	6***	56	61	5***	39	45	5***
Place of residence: Rural	31	44	13***	76	88	12***	55	68	12***
Total	26	38	12***	69	79	10***	49	60	11***

Note: Significance levels *** p<0.01, ** p<0.05, * p<0.1

3.4 Methods

This paper aims to empirically analyze the association between conflict exposure and measures of child mortality. Using a sample of women whose last birth occurred in the 5 years prior to the interview date, we estimate the Cox Proportional Hazard Regression Model to investigate the differences in childhood mortality, measured as under-five mortality, by exposure to conflict after controlling for socio-economic and demographic factors.

In our baseline approach, the under-five mortality is modelled as a function of exposure to conflict, and an array of socioeconomic, demographic and other control variables. These include: (i) mother's characteristics including age, age at the first birth, education; (ii) household's characteristics including head's age and sex, size, rurality, and wealth quintile; and (iii) province characteristics measured as the percentage of households in the poorest quintile at the provincial level.

Reliable estimation of the causal effect of conflict exposure on under-five mortality is challenging since conflicts are not exogenous. A particular region might have a long history of conflicts that may also be related to factors that contribute to child mortality. The literature on the causes of conflicts has shown that poverty, political instability, rough terrain, and large populations contribute to the high risk of experiencing conflict. Based on existing evidence, ethnic diversity is another important driver of conflict. Additionally, conflicts can be caused by mining, foreign aid and weather shocks. Some of these factors may also correlated with biased gender norms. For example, the literature suggests that economic development migrates gender inequality. On the other hand, natural resources abundance and weather shocks affect it adversely.

Naturally, it is not possible to control for all possible variables that might be correlated with conflict and child mortality. Nonetheless, we adopt an empirical strategy that allows us to mitigate the problem of unobserved heterogeneity to an extent. Given that the women in our sample are matched with conflict at the sub-national province level, we are therefore able to address significant sources of unobserved heterogeneity in cross-country studies, for example, those related to many of the institutional characteristics. Additionally, we control for time-fixed effects, thereby drawing comparisons across individuals within a country at a given point in time.

Mathematically, the Cox proportional hazard regression is expressed as follows:

$$\text{Under-five death}_{ipc}(t, X) = h_0\, \text{Conflict}_{ipc}(t) \exp(\beta_1 X_1 + \beta_2 X_2 \ldots\ldots \beta_k X_{k)} \quad (1)$$

X_i stands for covariates or explanatory variables, namely a series of mother/household controls from Table 1, province-level control for the percentage of households in the poorest quintile. The quantity $h_0(t)$ is the baseline or an underlying hazard function and corresponds to the probability of dying when all explanatory variables are zero. The regression coefficients β_s are the proportional changes in the hazards due to changes in explanatory variables (Goli et al., 2017).

The Cox proportion hazard regression assumes that the hazard of childhood death in no exposure to the conflict area (Z) is proportional to the hazard of childhood death with combined no exposure to conflict and exposure to conflict area (y)by the same factor Ψ at time t. Mathematically, it is expressed as follows:

$$h_z(t) = \Psi\, h_y(t) \quad (2)$$

When h_z and h_y are the hazards (probabilities of childhood deaths) for the two groups of children, non-conflict region versus conflict region, respectively, and Ψ is the hazard coefficient. The

hazard coefficient is interpreted as, if $\Psi > 0$, the hazard of childhood deaths is larger for children who are living in areas not exposed to conflict than for children who are living in the conflict-exposed area. On the other hand, if $\Psi < 0$, the hazard of childhood deaths is smaller for children who are living in areas not exposed to conflict than for children who are living in the conflict-exposed area.

4. Results

4.1 Incidence of conflict exposure and child mortality: baseline result

We empirically analyze the relationship between the incidence of conflict exposure and childhood mortality specific to under-five mortality. We provide results of Cox proportional hazard regression that examined the differences in under-five mortality rates among conflict-exposed regions adjusting for the effects of other potential confounders. The results are presented in Table 3, where Model 1 provides the bivariate associations between under-five mortality and exposure to conflict areas. In Model 2 and Model 3, we provide the results of the association between under-five mortality and exposure to conflict areas adjusting for the effects of other selected background characteristics known to influence childhood mortality. Regional variation has been captured by estimating this model including the same set of variables individually for Asia, Africa, and the World.

The unadjusted results in Model 1 shows that the hazard coefficient for under-five deaths is significantly higher in areas exposed to conflict than not exposed to conflict in Asia (hazard coefficient = 0.234; $p<0.01$), in Africa (hazard coefficient = 0.144; $p<0.01$) and also in the World (hazard coefficient = 0.186; $p<0.01$). Specifically, the findings imply that children living in conflict-exposed areas of Asia, Africa, and the World are 23%, 14%, and 19% more likely to die under age five respectively than those not exposed to conflict. In Model 2 and 3 we found consistent results, that is under-five deaths are significantly higher in areas exposed to conflict than in non-conflict zones and the results remain statistically significant even after controlling for various socioeconomic and demographic factors. Interpreted differently, In Model 3 the relative risk of experiencing a death under the age five years significantly decreases for Asia (hazard coefficient = 0.111; $p<0.01$), Africa (hazard coefficient = 0.0302; $p<0.01$) and for World (hazard coefficient = 0.168; $p<0.01$) as well. The hazard coefficient is 3 percent and still significant which shows that even accounting for other factors, the U5MR in exposed to conflict zones is higher than non-conflict zones. Overall the result suggests a significant and strong influence of conflict exposure in under-five childhood mortality throughout the World, as well as Asia and Africa.

The results of the other confounders are equally important for discussion. Mothers getting 4 or more ANC visits have 63% (hazard coefficient = -0.374; $p<0.01$) less chance in Asia, 88% (hazard coefficient = -0.116; $p<0.01$) less chance in Africa, and 80% (hazard coefficient = -0.202; $p<0.01$) less chance in the World of their children dying before the age of five. Institutional delivery is significantly preventing under-five mortality than home delivery. Environmental factors like drinking from piped water are showing significant result in Africa and the World. Accessibility to piped water makes the U5MR mortality rate less likely than those who have no access. Similarly, households using flush toilets and safe cooking fuel are less likely to lose a child than those using unhygienic practices.

Table 3: Estimates from Cox Proportional Hazard Model: Effect of conflict exposure status (5 years prior to the conception year) on U5MR.

Background Characteristics	Asia			Africa			World		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Not exposed to Conflict®									
Exposed to Conflict	0.234***	0.0769**	0.111**	0.144***	0.0801***	0.0302*	0.186***	0.132***	0.168***
	(-0.0325)	(-0.0375)	(-0.0468)	(-0.0171)	(-0.0178)	(-0.0182)	-0.0176	-0.0181	-0.0196
Less than 4 ANC visits®									
4 or more ANC visits			-0.374***			-0.116***			-0.202***
			(-0.0465)			(-0.0187)			-0.0168
Place of delivery-home®									
Place of delivery-institutional			-0.156***			-0.227***			-0.188***
			(-0.0446)			(-0.0198)			-0.0174
Child's birth order-1®									
Child's birth order-2		0.0547	0.0369		-0.0505*	-0.0764**		-0.0127	-0.0229
		(-0.0465)	(-0.0612)		(-0.0301)	(-0.0303)		-0.0241	-0.0262
Child's birth order-3		0.701***	0.513***		0.152***	0.119***		0.365***	0.266***
		(-0.0531)	(-0.0702)		(-0.0333)	(-0.0336)		-0.0271	-0.0293
Child's birth order- 4 and above		1.418***	1.167***		0.502***	0.447***		0.898***	0.723***
		(-0.0557)	(-0.0733)		(-0.0337	(-0.0342		-0.0275	-0.0299
Respondent is currently not working®									
Respondent currently working			0.188***			0.0785***			0.186***
			(-0.04)			(-0.0187)			-0.0159
Father education- below secondary®									
Father education- Secondary and higher		-0.0827**	-0.0829*		-0.144***	-0.112***		-0.114***	-0.175***
		(-0.0348)	(-0.0444)		(-0.0233)	(-0.0238)		-0.0181	-0.0199
Not using piped water®									
Using piped water		-0.0291	0.0101		-0.248***	-0.216***		-0.197***	-0.167***
		(-0.0355	(-0.0475		(-0.0244)	(-0.0248)		-0.0183	-0.0201
Not using flush toilet®									
Using flush toilet		-0.159***	-0.155***		-0.459***	-0.440***		-0.526***	-0.538***
		(-0.0365)	(-0.0471)		(-0.0406	(-0.0411)		-0.024	-0.0276
Not using safe cooking fuel®									
Using safe cooking fuel		-0.220***	-0.189***		-0.133***	-0.118**		-0.448***	-0.422***
		(-0.0436)	(-0.0557)		(-0.0458)	(-0.0463)		-0.0277	-0.0312
Mother's age		-0.0187***	-0.0182***		-0.0140***	-0.0137***		-0.0193***	-0.0193***

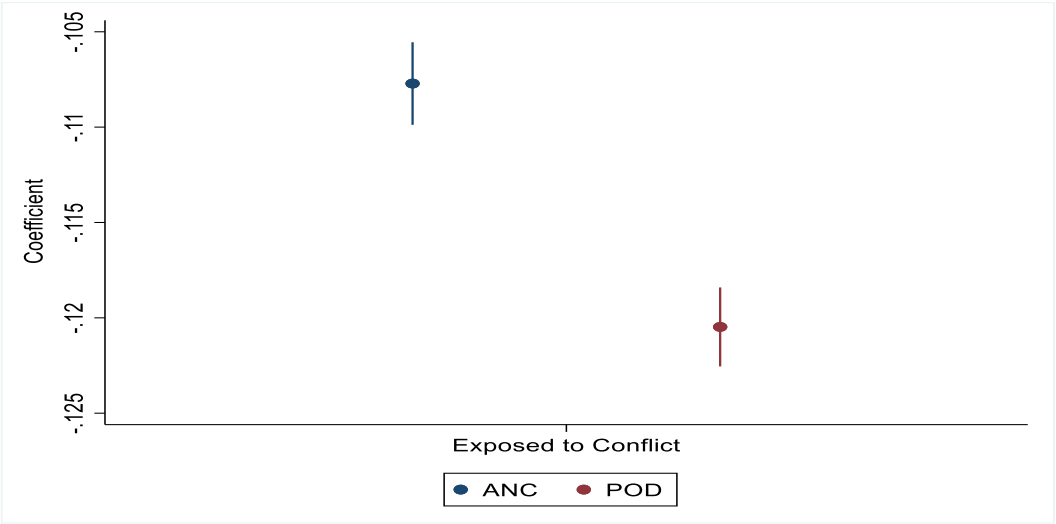
		(-0.00294)	(-0.00369)		(-0.0017)	(-0.00172)		-0.0014	-0.0015
Mother education- below secondary®									
Mother education- Secondary and higher		-0.439***	-0.382***		-0.241***	-0.175***		-0.425***	-0.293***
		(-0.036)	(-0.0512)		(-0.0267)	(-0.0274)		-0.0202	-0.0232
Household size - 1 to 4®									
Household size - 5 and more		-1.328***	-1.224***		-0.841***	-0.842***		-0.994***	-0.930***
		(-0.0387)	(-0.0508)		(-0.0221)	(-0.0224)		-0.0183	-0.0197
Household head's age		0.0158***	0.0156***		0.0127***	0.0130***		0.0138***	0.0142***
		(-0.00112)	(-0.00144)		(-0.00068)	(-0.00069)		-0.00056	-0.0006
Household head is female®									
Household head is male		0.110**	0.157**		0.0710***	0.0597***		-0.00539	0.00333
		(-0.0468)	(-0.0633)		(-0.0221)	(-0.0224)		-0.0188	-0.0201
Poor wealth quintile®									
Rich wealth quintile		0.0452	0.0159		0.032	-0.0266		-0.134***	-0.155***
		(-0.0433)	(-0.053)		(-0.0229)	(-0.0238)		-0.0185	-0.0202
Place of residence- rural®									
Place of residence- Urban		-0.145***	-0.0906*		0.0522**	0.0971***		0.0429**	0.0724***
		(-0.0398)	(-0.0493)		(-0.0241)	(-0.0246)		-0.0193	-0.0209
Percentage of households in poorest quintile at provincial level		0.00057	0.00318**			0.00304***			0.00157***
		(-0.00099)	(-0.00128)			(-0.000604)			-0.000531
Observations	4,29,200	4,06,209	2,43,745	4,84,640	4,57,748	4,52,650	10,81,711	10,12,603	8,30,801

Note ® Reference category; Standard errors are in parenthesis; *** p<0.01, ** p<0.05, * p<0.1

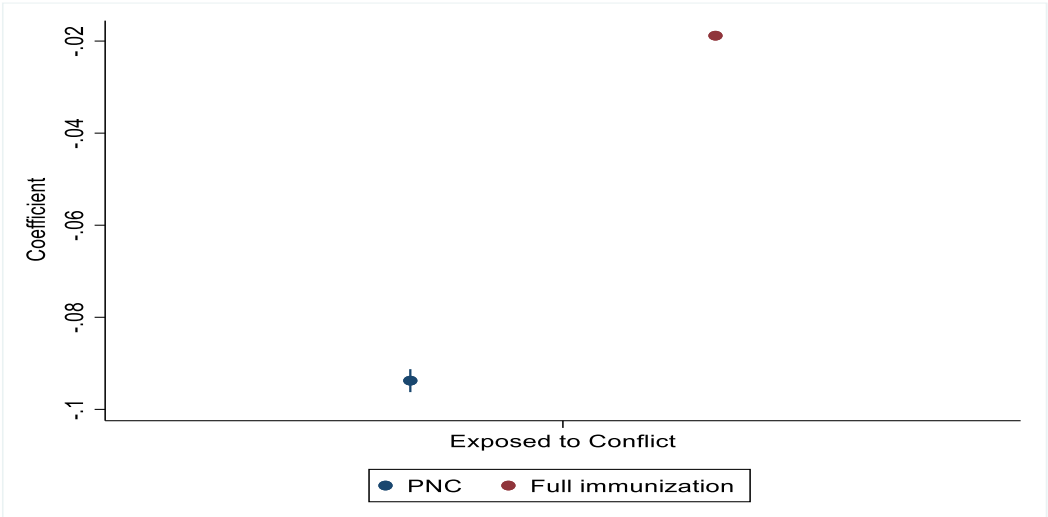
5. Mechanisms

We explored the underlying mechanisms mediating the impact of conflict exposure on Under-five mortality. We analyze the hypothesized relationship between conflict and maternal factors including ANC and PNC visits; conflict and personal illness control including full immunization and place of delivery (Fig 2A & 2B); conflict and nutrient deficiencies including stunting and underweight (Fig 2C). We can validate the previously mentioned prevailing hypothesis related to effect of conflict exposure status (5 years before conception) on the key child mortality determinants as the coefficient value is significant. The result validates the hypothesis showcasing a negative association of ANC, PNC, place of delivery, and full immunization and a positive association between stunting and underweight with the children exposed to conflict.

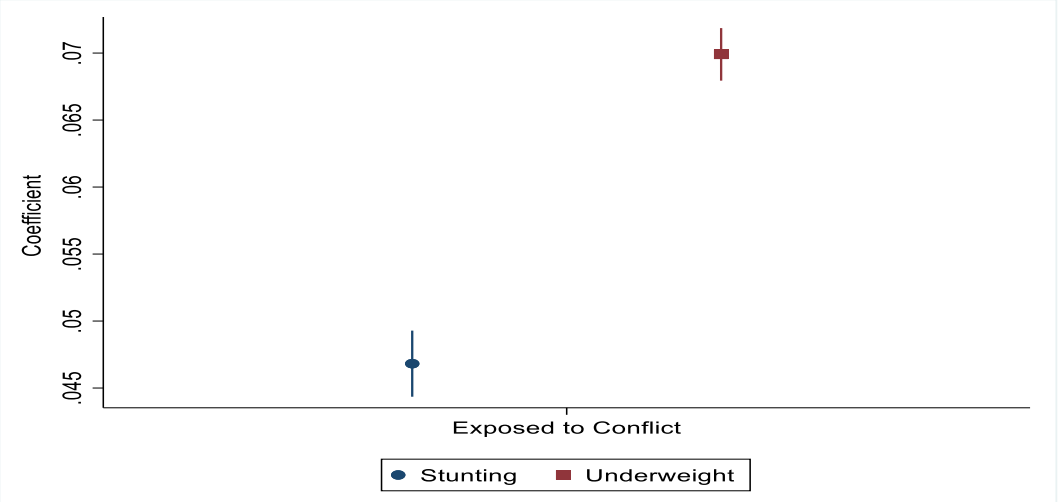
A. ANC and Place of Delivery (POD)



B. PNC and Full Immunization



C. Stunting and Underweight



Note: Regressions controlled for child, parents, and household Characteristics and Country dummies

Figure 2: Mechanisms: Effect of conflict exposure status (5 years before conception) on key child survival determinants viz. ANC, Place of Delivery (POD), PNC, Full Immunization, Underweight, and Stunting.

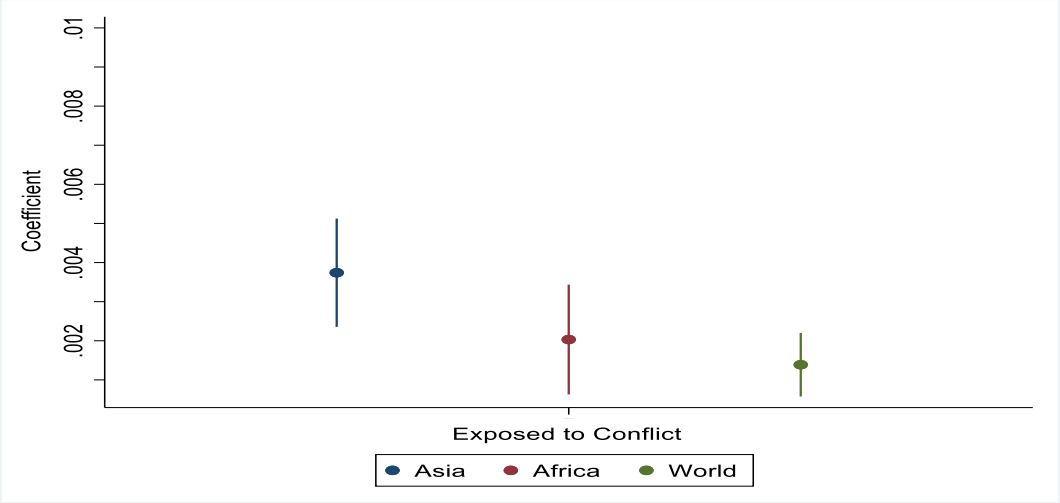
6. Robustness checks

Our baseline results consistently point to a negative significant relationship between children's lifetime conflict exposure and their childhood mortality outcomes. To test the reliability of these results, we conduct a series of robustness checks.

6.1 Estimates addressing unobserved heterogeneity

Our baseline regression controls for a large set of characteristics of individuals, their mothers, households, and locations. In particular, we include a control variable that measures the percentage of households in the poorest quintile at the province level (table 3). In an extended analysis (Fig 3), we also generated an additional measure of province characteristics: the percentage of households with major religion[2] (while also controlling for individual households' religious status). The inclusion of such province-level religion measures potentially controls for unobserved cultural characteristics that could be correlated with both conflict exposure and mortality outcomes. This information is not always available; thus, the sample was restricted based on the availability of religion information. The results were largely robust to augmenting the model with this additional province-level variable, despite the smaller sample size. The rationale behind the inclusion of these additional province-level control variables is to mitigate some of the unobserved heterogeneity at the province level, given that both heath and conflict outcomes may be jointly driven by the same unobservable.

[2] Major religion is defined as the religion followed by the largest share of surveyed households in each province.



Note: The model is controlled for the child, parents, and household Characteristics with the entity and time-fixed effects.

Figure 3: Effect of conflict exposure status (5 years before the conception year) on U5MR by region

6.2 Intensity of Conflict Exposure and Child Mortality

The influence of conflict on child mortality outcomes may be affected by the severity of the conflict. Therefore, we restrict the sample to only those children who live in areas where at least one violent conflict took place. we observe after imposing this sample restriction, that relative to a child who was exposed to conflicts that caused no deaths, children exposed to low, medium and high intensity conflict had poorer child survival leading to death. However, within this sample, there is no statistically significant difference in mortality outcomes by conflict exposure intensity measures.

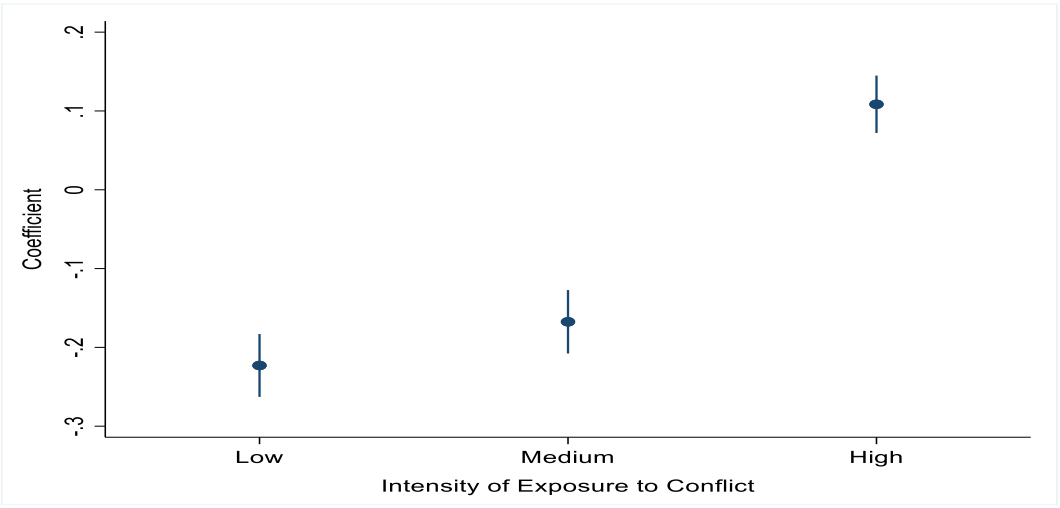
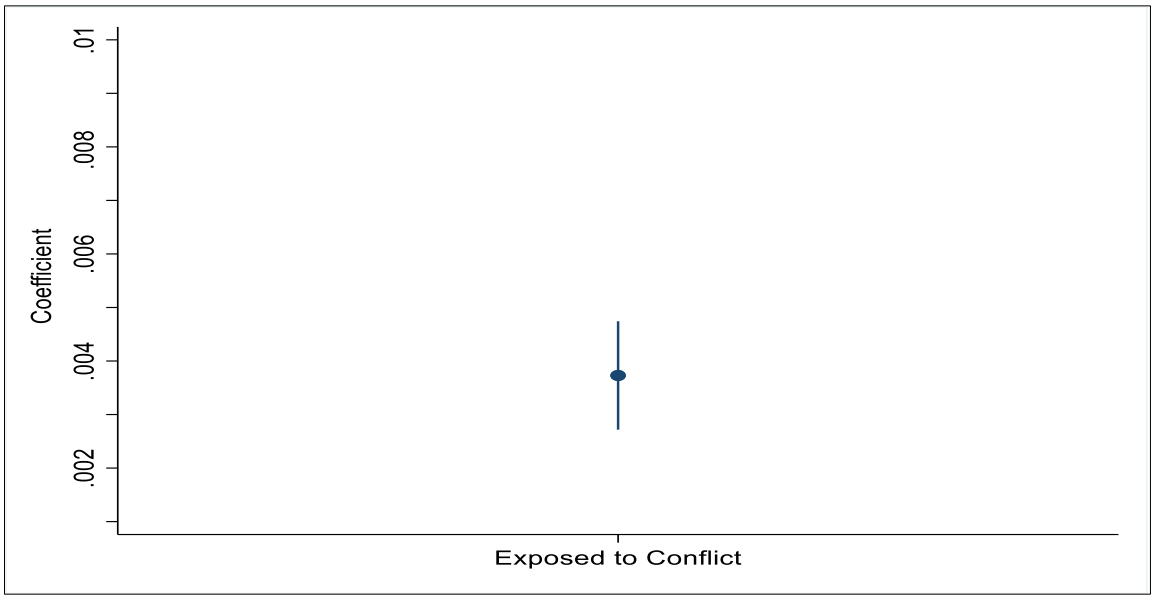


Figure 4: Estimates from Cox Proportional Hazard Model: Effect of intensity of conflict exposure (5 years prior to the conception year) on U5MR

6.3 *Estimates Based on Geo-Coded Data*

The heterogeneity in province size across countries may potentially have implications for the results. There are significant differences in average province size by country, as proxied by province population size. To account for this heterogeneity to an extent, we augment the regressions with a measure of province population size – see Fig 5 which shows that the results are not sensitive to this change in model specification.

As an additional attempt to better identify conflict exposure, we conduct additional analyses including geocoded data for the sample of children who were exposed to conflict from the year of conception to the survey year. We note that geocoded data are only available for 238,851 children. We calculate the distance in thousands of kilometers from each child's residence to the nearest conflict occurrence from conception year to survey year and use a log term of the distance in the analyses.

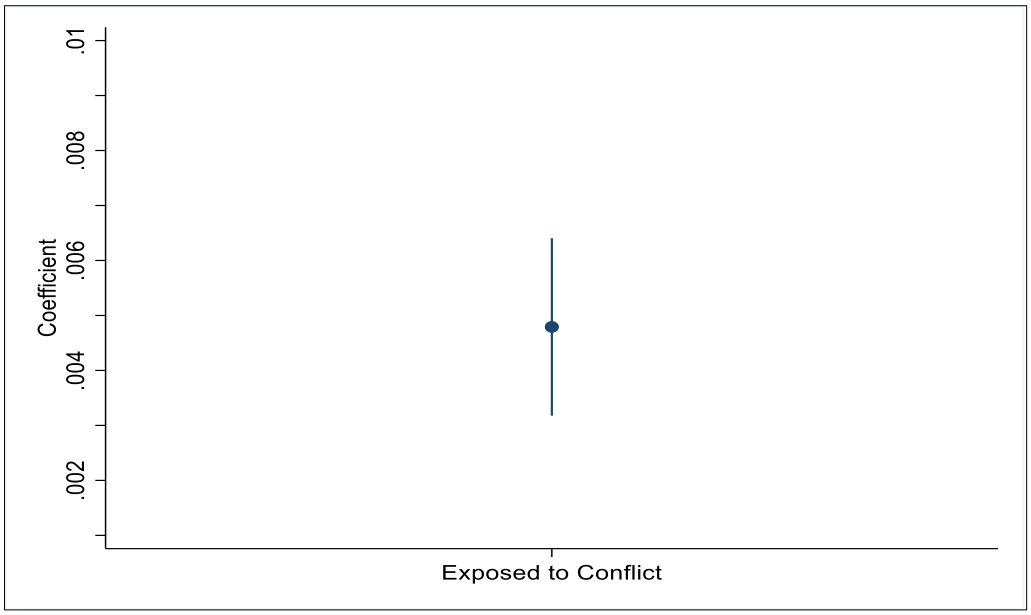


Note: Regressions controlled for child, parents, and household Characteristics and Year dummies.

Figure 5: Effect of conflict exposure (5 years before conception) on U5MR for Geo-coded sample

6.4 Estimated based on the sample with no migration history

Our measures of conflict exposure are linked to a child's location of residence at the time of the interview, and we derive their exposure retrospectively based on the timing of their conception. As such, we assume an absence of migration, which may be a strong assumption for some settings. To mitigate the potential problems associated with such an assumption, as a final robustness check, we limit the analysis sample to children with no migration history. As the results reported in Figure 6 show, the negative significant relationship between conflict exposure measures and child health outcomes largely persists within the non-migrant sample.



Note: Regressions controlled for child, parents, and household Characteristics and Year dummies.

Figure 6: Effect of conflict exposure (5 years before conception) on U5MR for non-migrant sample.

7. Conclusions

This paper employs geo-referenced data for three types of violent conflicts (*i.e. state-based, non-state, and one-sided* conflicts) from the *Uppsala Conflict Data Program (UCDP)* Georeferenced Event Dataset, to link the location of conflict incidents (both levels and severity of conflicts) with mother-children pairs using nationally representative household-level data from the *Demographic Health Surveys (DHS),* which use a uniform questionnaire across all countries and over time. This allows us to construct a large and unique database involving children from 52 countries over the period 1993-2018 to empirically test if exposure to violent conflict events has adverse outcomes on child mortality. Our bivariate estimate depicts the association between conflict exposure and childhood mortality from where it can be deduced that excess mortality is experiences by children exposed to conflict. The multivariate regression estimates show that even after controlling for a large array of socio-economic and demographic characteristics and location-fixed effects, conflict exposure is positively associated with child mortality, across all the defined measures of conflict. Proximate mechanisms explaining excess mortality in children exposed to conflict include poor maternal health outcomes (ANC and Institutional delivery care) and child health outcomes (height-for-age and weight-for-age z-scores) and immunization status. These findings are robust across a range of specifications, alternative measures of conflict, and sub-samples.

Our study significantly contributes to the existing literature, which hitherto has largely focused on single country-studies, using a single measure of conflict, or a single outcome measure. To the best of our knowledge, this is the first large-scale multi-country study on the role of conflict on child nutrition and immunization outcomes, over a twenty-year period. Our findings echo the conclusions arrived at from previous research and are robust across a range of specifications, alternative measures of conflict, and sub-samples. Moreover, the inclusion of a large range of countries over a long period, allows us to highlight key common factors that mediate the links between conflict exposure and child nutrition and immunization outcomes.

Our results suggest that maternal and child health needs to be an area of significant focus for policymakers in conflict-exposed areas. Our discussion of the mechanisms potentially mediating

the link between conflict and child health suggests that the destruction of health systems, infrastructure, and disruption to services can potentially play a role, and thus should be prioritized in policy interventions. In particular, policymakers must ensure that even during conflict periods, some maternal and child health services are rest should be maintained. Additional areas of policy intervention that may help in mitigating some of the adverse effects of conflict on child health include improvements in access to health care for both children as well as their careers, female education, and household living conditions, access to information on nutritious food.

However, our study is not devoid of some limitations. One of these is that this is a large multi-country study, and it is likely that we were not able to fully capture some country-specific issues. Moreover, due to data constraints, this study has been unable to incorporate the influence of the displaced people and refugees. Furthermore, the vaccination data does not allow us to identify the precise date of the vaccination.

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Appendix

Table A1: Descriptive statistics of the study variables

Background variables	Observations	Mean	Std. Dev.	Min	Max
Child is alive	943139	0.961	0.194	0	1
Exposure to conflict	943139	0.547	0.498	0	1
4 or more ANC	919814	0.522	0.5	0	1
Place of delivery	927820	0.613	0.487	0	1
Respondent currently working	785020	0.482	0.5	0	1
Birth space >=3 years from last birth	710702	1.488	0.5	1	2
Child's birth order	943139	2.636	1.197	1	4
Father's highest education	714937	1.232	0.997	0	3
Father with no education	943139	0.234	0.423	0	1
Father completed primary education	943139	0.19	0.393	0	1
Father completed secondary education	943139	0.258	0.438	0	1
Father completed higher secondary education	943139	0.076	0.265	0	1
Use piped water	924384	0.311	0.463	0	1
Use flush toilet	942812	0.3	0.458	0	1
Cooking fuel is electricity, LPG, and gas	910963	0.214	0.41	0	1
Mother's age	943139	28.653	6.77	13	49
Mother with no education	943139	0.347	0.476	0	1
Mother completed primary education	943139	0.248	0.432	0	1
Mother completed secondary education	943139	0.319	0.466	0	1
Mother completed higher secondary education	943139	0.074	0.262	0	1
Household head's age	943139	42.763	14.076	10	96
Household head is male	943139	0.846	0.361	0	1
Household size	943139	7.064	4.294	1	95
Rural	943139	0.676	0.468	0	1
Poorest	943139	0.236	0.425	0	1
Poorer	943139	0.215	0.411	0	1
Middle	943139	0.199	0.399	0	1
Richer	943139	0.183	0.387	0	1
Richest	943139	0.167	0.373	0	1
Percentage of households in the poorest quintile at the provincial level	943139	22.265	15.30	0	83.02
Place of residence	943139	1.676	0.468	1	2