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Article — Published Version

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Health Economics

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Suggested Citation: Meierrieks, Daniel; Schaub, Max (2024) : Terrorism and child mortality, Health Economics, ISSN 1099-1050, Wiley, Hoboken, NJ, Vol. 33, Iss. 1, pp. 21-40, <https://doi.org/10.1002/hec.4757>

This Version is available at:

<https://hdl.handle.net/10419/288238>

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Terrorism and child mortality

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Abstract

How does terrorism affect child mortality? We use geo-coded data on terrorism and spatially disaggregated data on child mortality to study the relationship between both variables for 52 African countries between 2000 and 2017 at the $0.5 \times 0.5^\circ$ grid level. Our estimates suggest that moderate increases in terrorism are linked to several thousand additional annual deaths of children under the age of five. A panel event-study points to economic effects that are larger and compound over time. Interrogating our data, we show that the direct impact of terrorism tends to be very small. Instead, we theorize that terrorism causes child mortality primarily by triggering adverse behavioral responses by parents, medical workers, and policy-makers. We provide tentative evidence in support of this argument.

KEY WORDS

Africa, child mortality, panel event-study, terrorism

JEL CLASSIFICATION

D74, I10, I12

1 | INTRODUCTION

Terrorism has become more common and deadly after 2001.¹ This is especially true for Africa, a continent that, over the last 15 years, has seen a spike in terrorist activity (Gaibullov & Sandler, 2019). At the same time, the continent is also plagued by comparatively high and persisting levels of child mortality (Burstein et al., 2019). Recognizing this concurrence, we ask whether terrorism leads to an increase in child mortality, and if so, why.

To this effect, we study the impact of terrorism on child mortality for a sample of 52 African countries between 2000 and 2017. We combine geo-coded data on terrorism with highly spatially disaggregated data on child mortality and morbidity at the $0.5 \times 0.5^\circ$ grid level. This allows us to track child mortality and its likely causes on a sub-national level. We contribute to the literature in several ways. First, by using high-resolution data for much of Sub-Saharan Africa and parts of Northern Africa over a long time span, we provide systematic evidence on the terrorism-child mortality nexus in this part of the world. Thus, our study complements a small number of case-studies on the consequences of terrorism for child health in Africa. For Burkina Faso and Nigeria, this evidence indicates that terrorism impedes access to perinatal healthcare (Chukwuma & Ekhatior-Mobayode, 2019; Druetz et al., 2020). For Cameroon, it has been shown that the Boko Haram insurgency is associated with lower height-to-weight ratios in children under five, likely caused by infectious diseases and the underutilization of health services (Kaila et al., 2021). We also add to extant research on the potentially adverse effects of terrorism on child health more broadly. For example, several empirical studies find that in utero exposure to terrorist attacks is associated with lower infant weight due to maternal stress and poor nutrition (e.g., Camacho, 2008; Lauderdale, 2006; Mansour & Rees, 2012;

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Quintana-Domeque & Ródenas-Serrano, 2017).² Second, our rich and fine-grained data makes it possible to apply a variety of econometric methods to more convincingly approximate causal estimates. Third, we explore potential direct and indirect pathways from terrorism to child mortality. Finally, we complement the empirical literature on the role of large-scale civil conflict (civil war) in child health.³ We believe that our focus on terrorism is worthwhile because of the substantial differences between terrorism and other forms of larger-scale armed conflict. Compared to interstate and civil wars, the level of violence associated with terrorism tends to be very low (Gaibullov & Sandler, 2019).⁴ Moreover, unlike rebel or regular armies, terrorist groups do not typically control territory, meaning that terrorism tends to create more diffused and punctuated threats rather than the objectively high threat levels affecting large areas associated with civil and interstate wars (Sambanis, 2008). These differences imply that the direct effects of violence on child mortality—due to direct targeting or the destruction of health infrastructure, for example,—ought to be much more limited. Instead, whatever effect we detect is likely driven by indirect effects stemming from behavioral responses to terrorist violence.

Employing a two-way fixed-effects approach, we show that higher levels of terrorist activity—operationalized as a terrorism index that accounts for both the frequency and intensity of terrorism—is associated with higher levels of child mortality. Using a panel event-study approach and a complimentary instrumental-variable (IV) approach that help to alleviate concerns about causal identification, we come to the same conclusion. The estimated effects are economically substantive, suggesting that plausible increases in terrorist activity are linked to several thousand additional deaths of children under the age of five per year. Interrogating our data, we show that the direct impact of terrorism (e.g., in terms of its lethality and destruction of public health infrastructure) tends to be small. This, in turn, suggests that increases in child mortality primarily emerge through the behavioral response of economic agents (e.g., parents, doctors, medical staff, aid workers and policymakers) to terrorism. Indeed, we provide tentative evidence that higher levels of terrorist activity unfavorably correlate with several proximate causes of child mortality such as the incidence of malaria and diarrhea, vaccination rates and malnourishment.

The rest of this paper is organized as follows. Section 2 discusses potential links between terrorism and child mortality and develops a testable hypothesis. We introduce the data on child mortality and terrorism in Section 3. In Sections 4 and 5, we empirically examine the terrorism-child mortality nexus. In Section 6, we explore potential transmission channels from terrorism to child health. Section 7 concludes.

2 | DIRECT AND INDIRECT EFFECTS OF TERRORISM ON CHILD MORTALITY

2.1 | Direct effects

Most obviously, terrorism can adversely affect child mortality when children are killed in a terrorist attack. What is more, children may be wounded in an attack in ways that are eventually lethal. Similarly, terrorism may kill or incapacitate the children's parents, doctors and other medical personnel or foreign aid workers. This, in turn, may also contribute to child mortality by denying children parental or medical care. Finally, terrorism may destroy public health infrastructure (e.g., hospitals), which would likewise have direct adverse consequences for children's health.

Still, while the direct effects of terrorism through the destruction of human life and the health infrastructure are eminently plausible, we do not expect them to affect child mortality in noticeable ways. This is because terrorism does not produce many victims, especially in comparison to many other sources of death. For instance, Arce (2019) estimates terrorism to lie in the bottom nine percent of the global burden of disease. That is, its burden is similar to that of Dengue fever and Vitamin A deficiency (Arce, 2019, p. 390). The direct impact of terrorism is also minor compared to other sources of violent death. For instance, for the early 2010s, Kamprad and Liem (2021) report that globally there were roughly half a million deaths per year from homicide (implying a homicide rate of 6.2 per 100,000 individuals), while terrorism accounted for approximately 38,000 deaths per year (implying a terrorism casualty rate of approximately 0.5 per 100,000 individuals).

2.2 | Indirect effects

It is more probable that the adverse consequences of terrorism for child mortality are due to its indirect effects. These indirect effects emerge from the behavioral response of a variety of economic agents (e.g., parents, especially mothers; doctors and other healthcare workers; the government) to terrorism. This response, in turn, affects both the demand for and supply of children's healthcare in ways that increase the risk of child mortality.

The parental perspective concerns the demand for children's healthcare. Here, we expect parents to be intimidated by terrorism. Indeed, the production of fear and intimidation for political leverage is a major goal of terrorist organizations (Gaibullov

& Sandler, 2019). What is more, Sunstein (2003) stresses the role of *probability neglect*, where individuals focus on a bad outcome (in our case, being harmed by a terrorist attack) but do not consider that this outcome is very unlikely to occur (as terrorism is very rare). Sunstein (2003) argues that the probability of harm is especially likely to be neglected when people's emotions are activated such as when their children's lives are threatened. The interplay between fear and probability neglect is consequently expected to lead to a behavioral response to terrorism on the part of affected parents that is potentially excessive. For instance, parents may forego preventive care (e.g., vaccinations or regular check-ups) out of fear that their children will be victimized by terrorism—a behavior that is expected to eventually contribute to higher levels of child mortality (e.g., Druetz et al., 2020; Rodríguez, 2022). That is, the interaction between fear of terrorism and probability neglect may lead parents to weigh the risk of their child being harmed by terrorism more strongly than the child's risk of being affected by infectious diseases or other preventable causes of harm, even though this is not warranted given the actual probabilities of suffering harm.

An stronger-than-warranted behavioral response due to fear of terrorism may also affect the supply of children's healthcare. Doctors, medical staff and international aid workers may stay at home rather than go to work, which could contribute to adverse consequences for children's health. At the same time, however, one could argue that the role of fear as a driving force of behavioral change in response to terrorism is less relevant for medical and aid workers as their professional experience may make them less vulnerable to emotional shocks.

However, we can still hypothesize about behavioral responses to terrorism by medical and aid workers by considering a rational-choice perspective. Indeed, a number of theoretical contributions apply this perspective to provide an economic analysis of terrorism (e.g., Becker & Rubinstein, 2011; Eckstein & Tsiddon, 2004; Naor, 2006; Sandler & Enders, 2004; Schneider et al., 2015). The rational-choice approach posits that individuals are utility-maximizers, and that terrorism affects the individual utility-maximization process by influencing the costs and benefits associated with certain activities, potentially effecting behavioral changes when new utility-maximizing choices emerge. For one, terrorism is expected to reduce the benefits associated with certain choices of action of doctors, medical staff and international aid workers. For instance, it may reduce the benefits of work when parents do not come to see doctor and thus do not pay for the doctor's services. For another, terrorism may impose additional costs on medical and aid workers, for example, by necessitating additional investment into personal security. *Ceteris paribus*, the advent of terrorism is thus expected to make activities that may involve encountering terrorism (e.g., providing aid to or working and making patient visits in terror-ridden areas) less attractive. Instead, doctors, medical staff and international aid workers are expected to opt for those activities that avoid terrorism as those activities are now more likely to maximize utility. For instance, high-skilled doctors and medical workers may migrate away from terror-affected areas (e.g., Dreher et al., 2011). Such behavioral adjustments that follow from utility-maximization considerations could eventually result in poorer supply of child healthcare and higher levels of child mortality.

Finally, terrorism may adversely affect the supply of healthcare by influencing public spending decisions. For one, the threat of terrorism may lead to increased public spending on security (e.g., Cevik & Ricco, 2020; Gupta et al., 2004). We can explain this shift in spending by political considerations, where policymakers offer voters (who are intimidated by terrorism) security spending as a solution to the terrorist threat; by satisfying public demand for security in this manner, policymakers hope to maximize voter support. Alternatively, one may argue that the government consciously withdraws public spending from terror-ridden areas as a form of punishment when it suspects the local population to support terrorist activity. In any event, a shift or withdrawal of spending may come at the expense of public health expenditure, especially when resources are scarce in the first place. Because of terrorism-induced cuts in spending there may be fewer resources available for clinics, doctors, prevention and vaccination programs or health education. This lack of funding, in turn, is expected to adversely affect child health.

2.3 | Main hypothesis

In line with our discussion, our main hypothesis is as follows:

Higher levels of terrorist activity result in a higher risk of child mortality.

In detail, terrorism may adversely affect children's health, first, through the destruction of human life and the health infrastructure (*direct effects*) and, second, due to the response of economic agents that undermines the adequate demand for and supply of children's healthcare (*indirect effects*). The behavioral response to terrorism may be related to psychological (fear and probability neglect), economic-rational (utility maximization) and political (public support and vote maximization) mechanisms. Given that terrorism's destructiveness tends to be comparatively low, we expect the various indirect consequences of terrorism to be the main reason for the hypothesized detrimental effect of terrorism on children's health.

3 | DATA

To test our main hypothesis, we use sub-national data aggregated at the $0.5 \times 0.5^\circ$ ($\sim 55 \times 55$ km at the equator) grid-year level using the *PRIO-GRID* (Tollefsen et al., 2012) for a maximum of 52 African countries and territories for the 2000–2017 period.⁵ The summary statistics for all variables employed in our analysis are reported in Supplementary Table 1.

3.1 | Measuring child health outcomes

Our main outcome of interest is *child mortality*, measured as the probability for a given child to die before reaching the age of five. The data comes from Burstein et al. (2019) who provide high-resolution (5 km^2) estimates for low- and middle-income countries covering the whole of mainland Africa and Madagascar for the 2000–2017 period. Their geospatial estimates are derived from the collection of available *Demographic and Health Surveys*, *UNICEF Multiple Indicator Cluster Surveys* and other country-specific surveys.⁶ We aggregate their data to the *PRIO-GRID* level. As part of our robustness checks, we also use two alternative child mortality measures from Burstein et al. (2019), *neo-natal mortality* (i.e., the risk of death for a new-born in the first 28 days after birth) and *infant mortality* (i.e., the mortality risk under the age of one).

As shown in Figure 1, regardless of which indicator we choose, mortality rates generally saw a noticeable decline over our period of observation. For instance, the average risk of death for children under the age of five was 12.8% in the year 2000 but fell to approximately seven percent in the year 2017. For our subsequent analysis, this implies that estimating the effect of terrorism on mortality outcomes primarily means assessing whether terrorism produced conspicuous setbacks from the general downward trend in mortality.

3.2 | Measuring terrorist activity

Our main independent variable is an *index of terrorist activity*. Similar to the index of Eckstein and Tsiddon (2004), it is defined as the sum of the per capita *number of terrorist attacks* and per capita *number of terrorism casualties* per grid-year observation. The term “terrorism casualties” refers to the number of individuals that are killed in a terrorist attack. The index reflects both the frequency (number of terrorist attacks) and ferocity (number of casualties) of terrorism. To reduce the influence of outliers, we apply the inverse hyperbolic sine transformation to our terrorism index.⁷ In weighing our terrorism variable by population size, we follow Jetter and Stadelmann (2019). They suggest that per capita measures of terrorism are more reflective of the (individual) risk associated with terrorism. As stressed above, we argue that it is this very risk that explains how terrorism may (indirectly) affect child mortality. Similar population-adjusted terrorism indicators are used in Tavares (2004), Gaibulloev and Sandler (2011) and Meierrieks and Gries (2013).

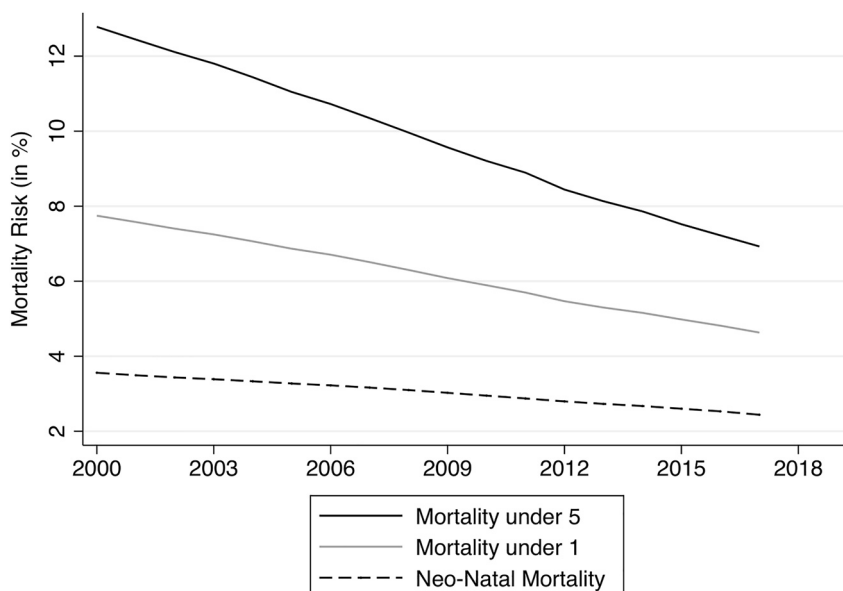
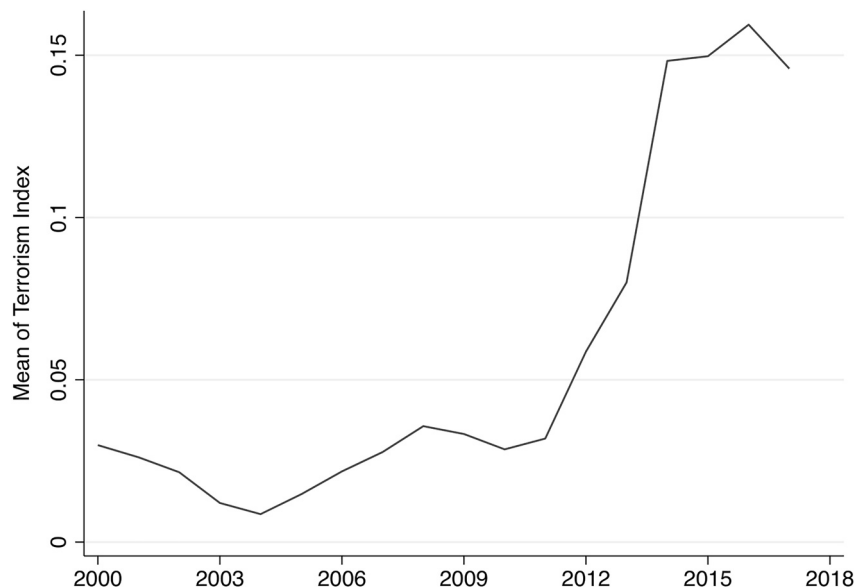


FIGURE 1 Mortality rates, 2000–2017.

FIGURE 2 Terrorism over time.



The data on grid-level population size (used to calculate the per capita rates) come from the *LandScan* high-resolution global population data set (Bright et al., 2018). The terrorism data are from the *Global Terrorism Database (GTD)*. The GTD was first described in LaFree and Dugan (2007). It collects information on terrorist activity from reputable media outlets.⁸ For a terrorist event to be recorded in the GTD, it must be documented by at least one high-quality media source (e.g., a renowned international newspaper such as the *New York Times*). To be considered a terrorist event, it must also (1) be intentional, (2) entail some level of violence or threat of violence and (3) be committed by non-state actors, meaning that violence by state actors is excluded (LaFree & Dugan, 2007). Furthermore, it must meet at least two of the following three criteria: (1) the incident must be carried out to achieve a political, economic, religious or social goal, (2) there must be evidence of an intention to coerce, intimidate or convey some other message to a larger audience than the immediate victims and/or (3) the incident must be outside the context of conventional warfare (LaFree & Dugan, 2007). The GTD provides geolocation information (latitude and longitude) on 99% of all attacks reported. This allows us to combine the terrorism index with our health data.

To add to the robustness of our findings, below we also use the constitutive parts of our terrorism index as explanatory variables, that is, the (inverse hyperbolic sine transformed) per capita number of terrorist incidents and the (inverse hyperbolic sine transformed) per capita number of terrorism casualties per grid-year observation. This is to assess whether any effect of terrorism on child mortality is due to the frequency or the ferocity of terrorism. Note, however, that the casualty variable is likely subject to under-counting as terrorism victim figures are unknown for many observations in the GTD.

Figure 2 visualizes the temporal trends in terrorism (indicated by the annual mean of the terrorism index) in Africa over our period of observation. There is a clear uptick in terrorist activity after 2011. While there were, on average, approximately 310 terrorist attacks per year between 2000 and 2011, the annual average was almost 2350 attacks from 2012 onwards. This increase can partly be attributed to stronger Islamist terrorist activity in the 2010s, for example, to attacks by *Al-Qaida in the Islamic Maghreb* in Algeria and Mali as well as *Boko Haram* in Nigeria, Niger and Chad. Furthermore, terrorism in Africa is linked to violent separatism such as in Ethiopia (e.g., by the *Oromo Liberation Front*) and Angola (e.g., by the *Front for the Liberation of the Enclave of Cabinda*).

3.3 | Geography of child mortality and terrorism

We illustrate the geographical distribution of child mortality and terrorism in Figure 3. The strength of the shading indicates the severity of child mortality, measured as the probability of a child to die before reaching the age of five, averaged over the 2000–2017 period and aggregated at the grid level. Figure 3 shows that child mortality rates are much higher in the Sahel and Central Africa compared to Southern and Northern Africa. Black dots indicate the location of individual terrorist attacks between 2000 and 2017. Some countries (e.g., the Comoros, Lesotho and Morocco) were almost completely unaffected by terrorism, while other countries (e.g., Algeria, Egypt and Nigeria) saw substantial terrorist activity. Finally, Figure 3 also points to a strong intra-country heterogeneity both with respect to child mortality and terrorism. For instance, the northern and south-eastern parts of Nigeria saw both markedly higher child mortality and more terrorist attacks than the rest of the country.

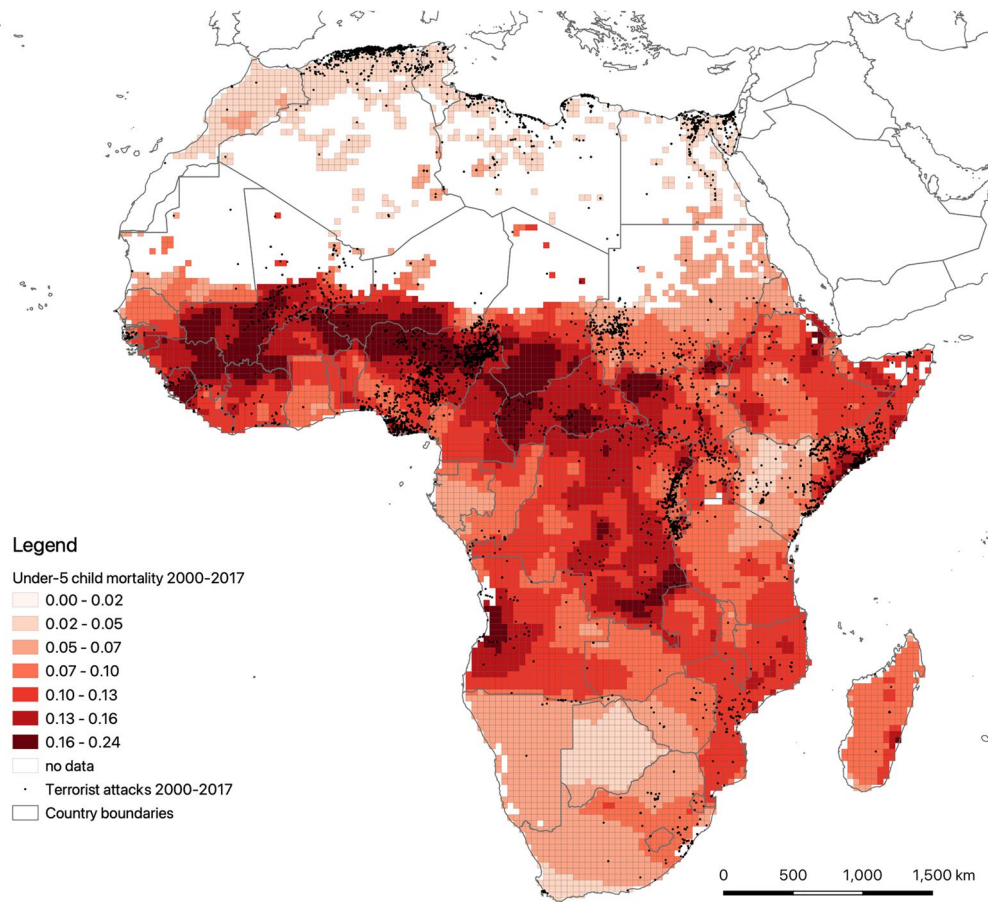


FIGURE 3 Geography of terrorism and child mortality. [Colour figure can be viewed at wileyonlinelibrary.com]

4 | TWO-WAY FIXED-EFFECTS APPROACH

4.1 | Empirical model

To study the relationship between children's health and terrorist activity, we consider the following two-way fixed-effects model, which we estimate using the OLS-estimator:

$$health_{k,it} = \beta_1 * terror_{j,it} + \beta_2 * X_{it} + \alpha_i + \lambda_t + v_{it} \quad (1)$$

Here, *health* refers to our *k*th measure of children's health in grid *i* and year *t*. Usually, this is the risk of child mortality for children under the age of five, but it may also indicate the neo-natal or infant mortality risk. The variable *terror* refers to our *j*th measure of terrorist activity. Commonly, we employ our terrorism index but as a robustness check we also use two alternative terrorism indicators.

We include grid-specific fixed-effects (α) to control for the role of time-invariant factors that may confound the relationship between terrorism and children's health. For instance, local geographical conditions (e.g., proximity to mosquito habitats) may be conducive to the spread of malaria, which, in turn, adversely affects children's health. At the same time, certain geographical conditions (e.g., proximity to forested areas) may provide potential militants with safe havens and thus facilitate terrorist activity (Fearon & Laitin, 2003; Schaub & Auer, 2023). Similarly, year-fixed effects (λ) control for the influence of global trends and events that may have affected terrorism and public health. For instance, the introduction or diffusion of medical technology during our period of observation may have reduced child mortality. Also, global trends in terrorism (e.g., the rise of *Al-Qaida* and the *Islamic State*) ought to have influenced terrorism in Africa.

Finally, we account for a set of time-variant confounders (*X*) that may affect both public health and terrorist activity and thus also obfuscate—due to omitted variable bias—the relationship between terrorism and child mortality. Because data on the controls is not available for all grids and years, our sample size is reduced when including them. When considering only the role

of terrorism (plus the fixed effects) in child mortality in a parsimonious model, our sample covers 7954 grids for the 2000–2017 period. A model that also considers the role of the various confounders allows us to draw on 6751 grids for the 2000–2015 period.

We control for (1) *nightlights* (i.e., light emissions during nighttime) as a measure of economic development, using data from Elvidge et al. (1997, 2021) and Ghosh et al. (2021); (2) *travel time to the nearest large city* as a measure of quality of local infrastructure, drawing data from Müller-Crepon (2021); (3) *urban population*, where the data are from an update of Meiyappan and Jain (2012); (4) *female education*, measured as the years of education of 20–24-year-old women, where the data are from Graetz et al. (2018); and (5) *temperature* (in °C) and *precipitation* (measured by the standardized precipitation evapotranspiration index), where the data are from Fan and van den Dool (2008) and Peng et al. (2019). We apply the inverse hyperbolic sine transformation to all controls except for the climate variables to correct for skewness.

All controls are expected to affect both the prevalence of terrorism and child health outcomes (Brockhoff et al., 2015; Craig et al., 2021; Eckert & Kohler, 2014; Freytag et al., 2011; Hahn et al., 2018; Kis-Katos et al., 2014; Meierrieks, 2021; Sheffield & Landrigan, 2011; Subbarao & Raney, 1995). For instance, we expect richer grids to see lower levels of child mortality (e.g., by virtue of better access to medical technology); at the same time, economic development may also affect terrorism, for example, by influencing its opportunity costs (Freytag et al., 2011; Kis-Katos et al., 2014).

4.2 | Empirical results

We report our findings in Table 1. We find that more terrorist activity is associated with higher levels of child mortality. This main finding is robust to the inclusion of the baseline controls. Considering economic substantiveness, our baseline estimates (Model (3), Table 1) suggest that an increase in terrorism by 10 percent is associated with an increase in child mortality of approximately 0.01% points. To give a comparison, an increase in economic development (nightlights) by 10 percent will yield a decrease in child mortality of approximately 0.02% points.

Our main finding is also robust to different measurements of mortality and terrorism. Concerning the latter, the association between the frequency of terrorism and child mortality appears to be somewhat stronger than the association between the lethality of terrorism and child mortality. Potentially, the ferocity of terrorism is more strongly clouded by uncertainty and underreporting, thus making behavioral responses to it by affected economic agents less straightforward.

Finally, allowing for a more complex lag structure with respect to the correlation between terrorism and the risk of child mortality suggests that this association becomes somewhat stronger over time.⁹ This may correspond to behavioral changes in response to terrorism that take some time to materialize. For example, this may pertain to a migratory response to terrorism on the part of medical workers, which, in turn, will only impact child mortality in subsequent years.

4.3 | Role of civil conflict and war

Above, we noted that terrorism is distinct from large-scale violence, for example, with respect to the number of casualties, the targeting of civilians and the control of territory by non-state actors (e.g., Sambanis, 2008). These differences motivated our empirical approach to study the terrorism-child mortality nexus. At the same time, however, one may point to potential overlaps between terrorist activity and larger-scale civil conflict (e.g., Findley & Young, 2012).¹⁰ If there is a systematic association between terrorism and larger-scale civil conflict, then an empirical investigation of the effect of terrorism on child health may also pick up the clearly established impact of civil conflict (e.g., Bendavid et al., 2021), thus over-estimating the impact of terrorism on child mortality.

To study this latter proposition, from the *UCDP Georeferenced Event Dataset* (Sundberg & Melander, 2013) we extract the number of deaths due to the use of armed force by an organized actor against another organized actors per grid-year observation. Analogous to our terrorism index, this death count is weighted by local population size and the inverse hyperbolic sine transformation is applied to it. These deaths will not be considered by the GTD as the GTD does not include activity by combatants (i.e., violence between organized actors such as the government against rebel groups). At the same time, our UCDP-based measure explicitly excludes violence against civilians because this might be included as terrorism by the GTD. Consequently, we are confident that using the UCDP and GTD data allows us to differentiate between small-scale terrorism (GTD) and large-scale civil conflict and war (UCDP). Indeed, the average number of victims per grid-year observation due to terrorism is 0.3, while it is 1.7 for civil conflict. The correlation between terrorism and civil conflict victims is positive but small ($r = 0.04$, $p < 0.01$).

TABLE 1 Two-way fixed-effects estimates.

Dependent variable →	(1) Mort. U5	(2) Mort. U5	(3) Mort. U5	(4) Mort. Neo	(5) Mort. U1	(6) Mort. U5	(7) Mort. U5	Mort. U5
Terrorism index	0.048*** (0.016)	0.088*** (0.020)	0.087*** (0.019)	0.014** (0.005)	0.058*** (0.011)			0.028* (0.015)
Terrorism index _{t-1}								0.071*** (0.015)
Terrorism index _{t-2}								0.125*** (0.015)
[Sum of coefficients]								[0.225]***
[Standard error]								[0.037]
Terrorist incidents p.c.						0.167*** (0.030)		
Terrorism casualties p.c.							0.071*** (0.021)	
Nightlights			-0.225** (0.106)	-0.163*** (0.024)	-0.219*** (0.053)	-0.225** (0.107)	-0.226** (0.107)	-0.133 (0.089)
Distance to city			0.411*** (0.099)	0.170*** (0.027)	0.120** (0.055)	0.413*** (0.099)	0.411*** (0.099)	0.266*** (0.094)
Urban			-1.778*** (0.649)	-0.326** (0.149)	-0.560 (0.342)	-1.767*** (0.649)	-1.775*** (0.649)	-1.918*** (0.644)
Female education			-0.443*** (0.038)	-0.145*** (0.011)	-0.190*** (0.022)	-0.444*** (0.038)	-0.442*** (0.038)	-0.275*** (0.042)
Temperature			0.023** (0.009)	-0.001 (0.002)	0.007 (0.004)	0.023** (0.009)	0.023*** (0.009)	0.021*** (0.008)
Precipitation (SPEI)			0.003 (0.003)	0.004*** (0.001)	0.001 (0.002)	0.003 (0.003)	0.003 (0.003)	0.019*** (0.003)
Observations	142,473	101,089	101,089	101,089	101,089	101,089	101,089	87,528
Number of grids/clusters	7954	6751	6751	6751	6751	6751	6751	6746
Adjusted R ²	0.95	0.96	0.96	0.95	0.95	0.96	0.96	0.96

Note: Mort. U5=Mortality risk of children under the age of five. Mort. Neo = Mortality risk of children in first 28 days after birth. Mort. U1=Mortality risk of children under the age of one. Grid- and year-fixed effects always included. Standard errors clustered at the grid-level in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For our empirical analysis of the role of civil conflict, in addition to the (inverse hyperbolic sine transformed) per capita number of battle deaths, we also consider a binary measure that is equal to unity when there is at least one battle death and a dichotomous measure of civil war that is equal to unity when a grid observation sees at least 25 battle deaths per year (which is a common civil war death threshold; see Blattman & Miguel, 2010). In addition, we run two models where we drop all grid-year observations when they see at least one battle death or all grids with any battle death during our period of observation (even when they experience years without battle deaths), respectively.

As shown in Supplementary Table 2, we find that the positive association between terrorism and child mortality holds after controlling for various measures of civil conflict/war and when excluding civil conflict grids and episodes. Here, the point estimates concerning the association between terrorism and mortality are—as expected—somewhat smaller but still reasonably close to our baseline results reported in Table 1. Our results suggest that increases in both the scope of terrorism and civil conflict have a comparable association with child mortality. For instance, a 10 percent increase in the terrorism index and a 10 percent increase in the number of battle deaths are both expected to increase the child mortality risk by approximately 0.01% points. The latter positive association between civil conflict and child mortality is consistent with earlier findings such as Bendavid et al. (2021). At the same time, the results reported in Supplementary Table 2 indicate that terrorism shares an unfavorable relationship with child mortality that is independent of the impact of larger-scale conflicts.

4.4 | Further robustness checks

In addition to considering the role of civil conflict, we also probe whether our findings are robust in several other ways. These checks concern (1) different operationalizations of the terrorism variable as well as (2) changes to the set of confounders, (3) the inverse hyperbolic sine transformation of our main dependent variable, (4) the use of data that is averaged over 4 years and (5) the use of alternative standard errors (e.g., Driscoll-Kraay standard errors) that are robust to potential spatial autocorrelation.¹¹ Reassuringly, using alternative measurements of terrorism yields results that are similar to those reported above (Supplementary Table 3). Similarly, the use of alternative or additional confounders, the transformation of the dependent variable, as well as the use of average data and alternative standard errors does not affect our main conclusion of an unfavorable association between terrorism and child mortality (Supplementary Table 4).

4.5 | Instrumental-variable estimates

We also conduct a complimentary instrumental variable (IV) approach. We discuss this approach in more detail in the Appendix. There, we instrument terrorism with non-violent dissent, a well-known precursor of terrorist activity (Bakker et al., 2016; Sprinzak, 1991). Our IV-results confirm that higher levels of terrorist activity result in higher levels of child mortality (Supplementary Table 7). At the same time, we acknowledge that our instrument may be potentially unsound. For instance, there may be concerns about the validity of the exclusion restriction, that is, the assumption that social protests—a complex phenomenon—only relate to child mortality via their effect on terrorism. We therefore probe the validity of the exclusion restriction by means of the plausibly exogenous framework (Conley et al., 2012; van Kippersluis and Rietveld, 2018), showing that considerable violations of this restriction are necessary to overturn our finding of an unfavorable effect of terrorism on child mortality (Supplementary Table 9). Still, we caution the reader to keep in mind the well-known shortcomings inherent to IV-approaches and thus consider the IV-estimates to only provide supporting but not definite evidence in favor of our main hypothesis.

5 | PANEL EVENT-STUDY APPROACH

5.1 | Empirical model

To further strengthen our claim that the effect of terrorism on child mortality risk is indeed causal, we resort to the panel event-study approach as an alternative empirical method. This method is related to difference-in-differences and two-way fixed effect approaches; for further discussion of this approach, we refer to Clarke and Tapia-Schythe (2021), Sun and Abraham (2021) and Freyaldenhoven et al. (2021). For the panel event-study approach, we consider the following model:

$$health_{it} = \sum_{m=-G}^M \beta_m td_{i,t-m} + \beta_2 * X_{it} + \alpha_i + \lambda_t + v_{it} \quad (2)$$

The dependent variable, fixed effects and controls are defined and operationalized as above. In contrast to previous models, Equation (2) includes the term td , a dummy variable that allows us to estimate the dynamic effect of a terrorism treatment on the outcome. Here, the outcome at time t can only be directly affected by the value of the terrorism treatment variable, td , at most $M \geq 0$ periods before t and at most $G \leq 0$ periods after t .

The dummy variable td changes once a specific grid switches from the “no terrorism” to the “sustained terrorism” state. That is, the variable td is equal to zero in periods before this switch and equal to unity in the period of the switch and thereafter. Here, “sustained terrorism” means that (1) the mean-level of terrorist activity (either in terms of our terrorism index or the per capita number of terrorist incidents or casualties, respectively) is above its sample-mean and (2) there are at least 2 years of terrorist activity. By using this definition of the terrorism event, we exclude grids that are barely affected by terrorism; for these grids, a behavioral response to terrorism seems unlikely. Grid-cases that do not meet these two criteria are the counterfactuals where td is always equal to zero. Given the definition of the treatment variable td , in our analysis we thus consider an absorbing treatment such that the treatment status is a non-decreasing series of zeros and ones (Sun & Abraham, 2021).

By examining the variation in child mortality risk around the beginning of sustained terrorist activity (as defined above) compared with a baseline reference period, we can estimate both events leads ($M \geq 0$ periods before the treatment) and event lags $G \leq 0$ periods after the treatment (Clarke & Tapia-Schythe, 2021). For our analysis, we choose an effect window of

$G = M = 4$. The baseline reference period for our analysis is always $\beta_{-1} = 0$, meaning the period before the switch from “no terrorism” to “sustained terrorism” occurs. This normalization is necessary to avoid collinearity issues. Below, we summarize the lags and leads estimates in graphical form as an event-study plot, following Freyaldenhoven et al. (2021). Here, the normalization at $\beta_{-1} = 0$ means that the plotted coefficients can be interpreted as estimated effects relative to the period before the switch to “sustained terrorism”.

An important assumption associated with Equation (2) is that in the absence of the treatment (i.e., without the emergence of sustained terrorism), trends in child mortality risk would be parallel in treated and untreated grids. Given that the counterfactual trend is unobserved, we cannot directly test this assumption. However, we can study whether there is evidence for non-parallel pre-trends occurring before the event of interest happens, which would cast doubt on the parallel trend assumption, implying anticipatory behavior or the presence of a confounder. For instance, doctors and aid workers may expect terrorist violence to break out soon and emigrate from such potentially threatened areas; this, in turn, would adversely affect child health even before sustained terrorist violence erupts. Consequently, following Freyaldenhoven et al. (2021), in Supplementary Table 5 we always report the pre-trend tests, running a Wald test with the null hypothesis that all the pre-event coefficients are equal to 0.

5.2 | Empirical results

We present our estimates for Equation (2) in Supplementary Table 5. Below, we report the associated event-study plots in Figures 4–6, using the terrorism index, terrorism incidents or terrorism casualties, respectively, to define the terrorism treatment. Figures 4–6 report the conventional 95% confidence intervals as they follow from the two-way fixed-effects estimates.¹² We also report the sample-mean of the dependent variable (under-five child mortality risk, number in parentheses on the y-axis) one period before the treatment occurring to make it easier to evaluate economic significance (Freyaldenhoven et al., 2021).

Inspecting Figures 4–6 and the full results reported in Supplementary Table 5, our findings can be summarized as follows. First, regardless of which terrorism variable we use, switching from the “no terrorism” to the “sustained terrorism” state always results in an increase in child mortality risk. These results are also economically substantive. For instance, in the period after the treatment sets in (i.e., at $t = 1$), the child mortality risk is estimated to increase by 0.14% points [95% CI: 0.02; 0.25] (terrorism index), 0.22% points [95% CI: 0.03; 0.41] (terrorism incidents) and 0.18% points [95% CI: 0.04; 0.31] (terrorism casualties), respectively. Second, the strength of this effect accumulates over time. The initial upward movement in effect strengths may be because certain behavioral adjustments to terrorism (e.g., migration) take some time, consequently also leading to a lagged effect on child mortality. Growing statistical imprecision notwithstanding, we find no clear evidence of an eventual decline in effect sizes which would be explainable by attenuation effects caused by individuals ‘getting used to’ terrorism (Blasco et al., 2022). Finally, there is no evidence that pre-event leads affect the dependent variable. This latter conclusion is also supported by the test of pre-trends reported in Supplementary Table 5. This strengthens our argument that the identifying assumption (parallel post-event trends in the absence of the treatment) of the model is met.

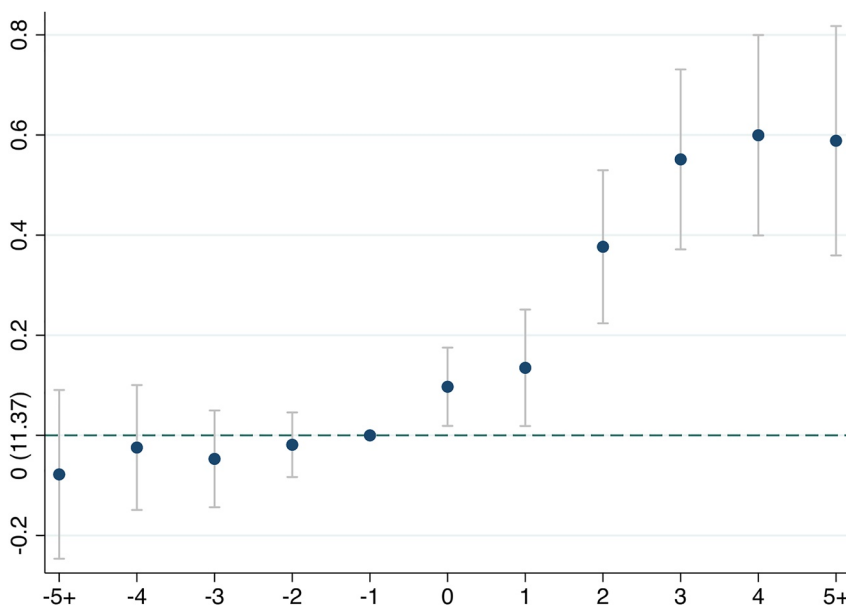


FIGURE 4 Event-study plot (terrorism index). [Colour figure can be viewed at wileyonlinelibrary.com]

FIGURE 5 Event-study plot (per capita terrorist incidents). [Colour figure can be viewed at wileyonlinelibrary.com]

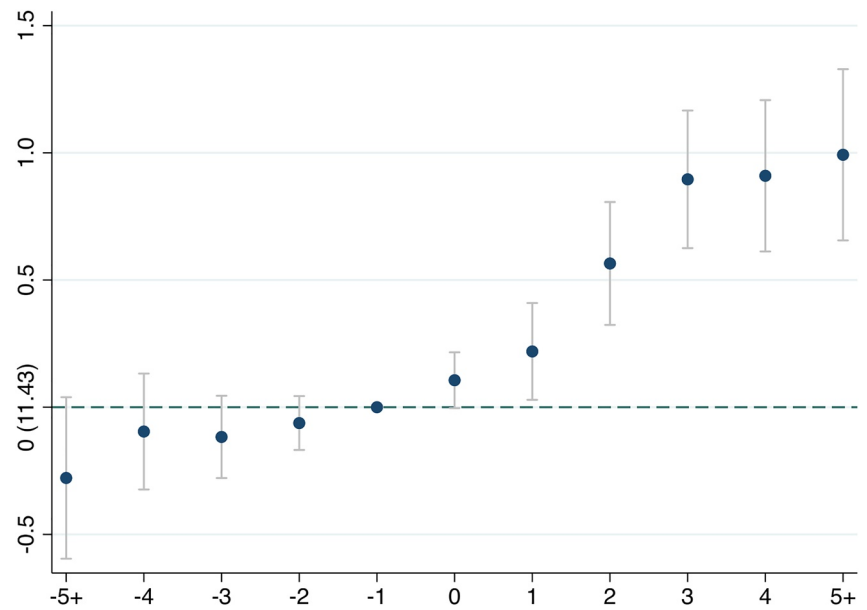
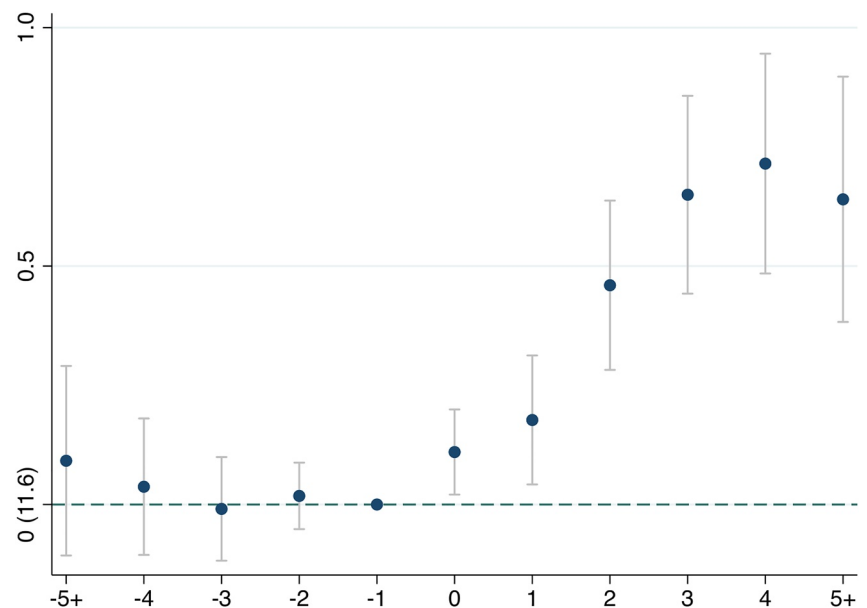


FIGURE 6 Event-study plot (per capita terrorist casualties). [Colour figure can be viewed at wileyonlinelibrary.com]



5.3 | Robustness checks

Above, we used specific criteria to differentiate between treated and untreated grids. In Supplementary Table 6, we assess how robust our empirical results are to different operationalizations of the treatment. Specifically, we consider different cut-offs with respect to the level of terrorism or the duration of terrorist activity to define the beginning of a sustained terrorist threat affecting a specific grid. As reported in Supplementary Table 6, changing the definition of the treatment variable does not affect our main empirical conclusion that grids treated by sustained terrorist activity see higher levels of child mortality risk compared to the untreated grids. What is more, we never find evidence indicating the presence of pre-trends, supporting the causal interpretation of the panel event-study estimates.

6 | EXPLORATION OF MECHANISMS

Through our previously presented empirical efforts, we have demonstrated that higher levels of terrorist activity are linked to higher levels of child mortality. In this sub-section we explore through which mechanisms this effect may materialize.

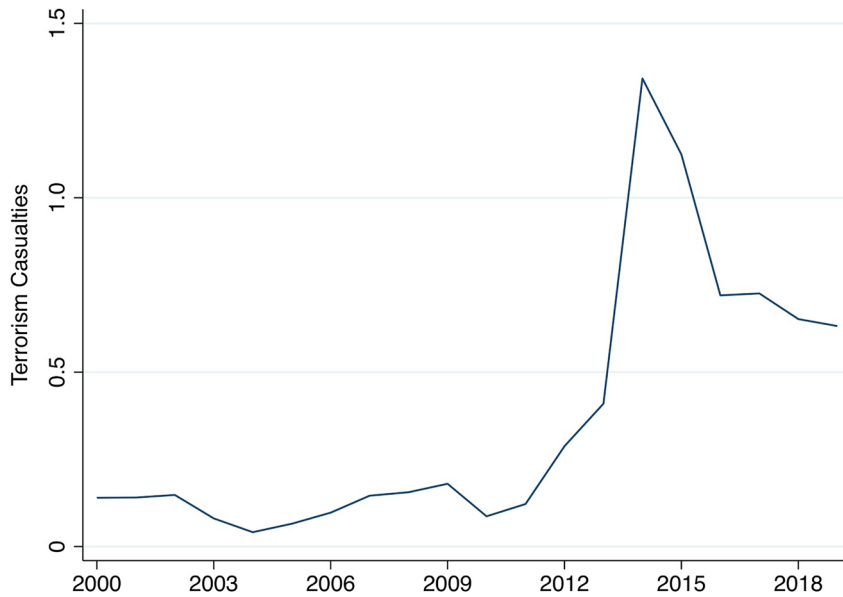


FIGURE 7 Mean-number of terrorism casualties per grid. [Colour figure can be viewed at wileyonlinelibrary.com]

6.1 | Potential direct effects through destruction

Above, we argued that terrorism may directly contribute to child mortality by victimizing children and their caretakers as well as by destroying the public health infrastructure. With respect to terrorism casualties, the GTD data does not provide concrete information on the number of children (or parents) killed in terrorism. However, we have information on the total number of terrorism casualties. The GTD tells us that terrorism killed approximately 78,000 individuals between 2000 and 2017 (or approximately 4300 victims per year) for the grids and countries considered in our analysis. As shown in Figure 7, this amounts to less than one individual being killed by terrorism on average per grid-year pair.

At the same time, according to the *United Nations Department of Economic and Social Affairs*, there were on average approximately 36 million births per year in Africa.¹³ Given that the risk of under-five child mortality over the time period under consideration was approximately 11% (see Supplementary Table 1), this implies that almost four million out of these 36 million children died before reaching the age of five.¹⁴ Accordingly, even if a quarter of all annual terrorism casualties were children under the age of five (which is a very strong assumption), this would mean doubling this casualty number (from approximately 1100 to 2200 children per year) would only have a miniscule effect, increasing the child mortality risk by approximately 0.025% points. In sum, these back-of-the-envelope calculations point to a very benign *direct* effect of terrorism on child mortality.

Interrogating the GTD data with respect to the direct effect of terrorism on the public health infrastructure paints a similar picture. The GTD provides information on the targets of terrorist attacks. Reporting issues notwithstanding, out of the approximately 22,500 terrorist incidents recorded in our African sample between 2000 and 2017, only approximately 120 attacks were directed against public health infrastructure targets such as clinics, ambulances and pharmacies.

6.2 | Correlations between terrorism and proximate causes of child mortality

Given that its direct effects are rather innocuous, terrorism's indirect effects seem to play a more important role. This is also in line with our conceptual argument outlined above. Terrorism, we argued, can increase child mortality by producing a behavioral response in economic agents (parents, doctors, government officials etc.) that disbenefits child health. Ideally, we would want to directly measure such behavioral reactions, for example, changes in parental decision-making in response to terrorism. Unfortunately, our data does not permit us to do this. However, we do have data on various proximate causes of child mortality, which allow us to come to some very tentative conclusions regarding potential mechanisms. We study how terrorism correlates with these proximate mortality causes by considering the following two-way fixed-effects model:

$$cause_{j,it} = \beta_1 * terror_{it} + \beta_2 * X_{it} + \alpha_i + \lambda_t + v_{it} \quad (3)$$

The main explanatory variable, *terror*, and the remaining controls and fixed-effects are as described above. The dependent variable, *cause*, refers to the *j*th proximate cause of child mortality. We consider the following four variables aggregated at

the grid-level: (1) the incidence of *malaria* as measured by the annual number of children under four who become infected by *Plasmodium falciparum*, (2) the under-five annual incidence rate of serious *diarrhea*, (3) *diphtheria-pertussis-tetanus vaccine coverage* measured as the share of one- and two-year-old who are fully vaccinated and (4) *malnourishment*, measured as the share of under-five year old children that are underweight. The malaria and diarrhea incidence rates are from Weiss et al. (2019) and Reiner et al. (2018), respectively, while the vaccination and malnourishment data are from Mosser et al. (2019) and Osgood-Zimmerman et al. (2018), respectively.¹⁵

6.3 | Empirical results

We report our empirical findings in Table 2. As shown in Panel A, terrorism positively correlates with the incidence of malaria and diarrhea. It is also positively associated with the risk of malnutrition. This correlation, however, is fairly weak, which may speak to the notion that the effect of terrorism on economic activity (which directly affects the ability to purchase food) tends to be rather small (e.g., Gaibullov & Sandler, 2019). Finally, terrorism also negatively correlates with vaccination rates. What is more, in Panel B of Table 2, we show that the various proximate causes of child mortality, in turn, unfavorably correlate with child mortality. For instance, lower vaccination rates are associated with a higher risk of child mortality.

On the one hand, the findings reported in Table 2 very tentatively support our theoretical claims. For example, the reported correlations could be consistent with the argument that terrorism produces fear among parents, making it less likely that they receive a sound health education (e.g., concerning malaria prevention) or seek preventive checkups for their children (which could reduce vaccination rates). On the other hand, however, we also must highlight the limits of this analysis. First, our fixed-effects estimates do not allow us to make causal claims about the relationship between terrorism and the spread of disease as well as lack of medical care and food. Second, the proximate causes of child mortality we consider may not only be affected by the psychological and behavioral response to terrorism. For instance, the spread of malaria may also be due to climatic changes that our empirical model does not adequately account for. In other words, omitted variable bias may affect our findings. Finally, due to a lack of data we cannot consider many potentially important transmission channels. For instance, this includes changes in grid-specific development aid provision and public spending on health. In sum, the results reported in Table 2 are primarily informative in that they hint at suggestive correlations that might stimulate more extensive research in the future.

7 | CONCLUSION

We study the relationship between terrorism and child mortality using high-resolution sub-national data (at the $0.5 \times 0.5^\circ$ grid-year level) for 52 African countries and territories between 2000 and 2017. We rely on two-way fixed effects estimates, a complementary IV strategy and a panel event-study to examine whether terrorism adversely affects child mortality risk.

While each econometric method we employ in our study has potential disadvantages, all empirical approaches point in the same direction: terrorism adversely influences child mortality in the African countries and territories we consider. Using our preferred two-way fixed-effects specification, we estimate that an increase of our terrorism index by 50% raises the child mortality risk by 0.04% points [95% CI: 0.02; 0.06].¹⁶ Similarly, the panel event-study estimates suggest that the beginning of sustained terrorist activity leads to a contemporaneous rise in child mortality risk by approximately 0.10% points [95% CI: 0.02; 0.17]. An interesting avenue of future research could be to study heterogeneity in the terrorism-child-mortality nexus with respect to specific types of terrorism being especially impactful (e.g., terrorism against civilian vis-à-vis military targets). Such heterogeneity could also be influential on econometric grounds (Sun & Abraham, 2021).

To put the estimated effect sizes into perspectives, we use figures on live births provided by the *United Nations Department of Economic and Social Affairs*. These figures indicate that for our African sample and observation period there were approximately 36 million births per year. Assuming a risk of under-five child mortality of approximately 11% (as our sub-national data suggests), this implies that almost four million out of these 36 million lives ended before a child reaches the age of five. *Ceteris paribus*, an increase of our terrorism index by 50% would mean an increase (in the same year) of child deaths before the age of five by 16,000 individuals [95% CI: 8,000; 24,000] (two-way fixed effects). Similarly, the panel event-study estimates suggest that the beginning of sustained terrorist activity will result in approximately 40,000 additional deaths of children under five per year in the same year [95% CI: 8,000; 68,000], with effects becoming more pronounced in latter periods.

We can also relate these estimates to other causes of child mortality in Africa. For instance, Liu et al. (2012) report the causes of child mortality for Africa for the year 2010. Our estimated effect of an additional 40,000 deaths of children under the age of five due to terrorism is approximately comparable to child mortality in Africa due to measles or tetanus in 2010.¹⁷

TABLE 2 Potential transmission channels.

Panel A: Correlation of terrorism and potential mediators				
Dependent variable →	(1a) Malaria	(2a) Diarrhea	(3a) Vaccinations	(4a) Malnutrition
Terrorism index	0.004*** (0.001)	0.007*** (0.001)	−0.002** (0.001)	0.001* (0.000)
Nightlights	0.016 (0.010)	0.002 (0.007)	−0.022*** (0.006)	0.012*** (0.002)
Distance to city	−0.059*** (0.010)	0.063*** (0.009)	0.069*** (0.008)	−0.001 (0.003)
Urban	−0.063 (0.062)	−0.163*** (0.037)	0.232*** (0.042)	0.035*** (0.015)
Female education	0.015*** (0.004)	−0.044*** (0.003)	0.022*** (0.003)	−0.033*** (0.001)
Temperature	0.007*** (0.001)	0.001 (0.001)	0.006*** (0.001)	0.001*** (0.000)
Precipitation (SPEI)	0.003*** (0.001)	−0.001 (0.001)	−0.002*** (0.000)	0.000 (0.000)
Adjusted R^2	0.93	0.93	0.93	0.95

TABLE 2 (Continued)

Panel B: Correlation between potential mediators and child mortality				
Mediator variable →	(1b) Malaria	(2b) Diarrhea	(3b) Vaccinations	(4b) Malnutrition
Mediator				
	1.173*** (0.071)	1.659*** (0.100)	−1.481*** (0.129)	6.950*** (0.446)
Nightlights	−0.360*** (0.106)	−0.233** (0.104)	−0.258** (0.107)	−0.312*** (0.101)
Distance to city	0.535*** (0.099)	0.308*** (0.099)	0.516*** (0.099)	0.417*** (0.095)
Urban	−1.996*** (0.660)	−1.490** (0.634)	−1.419** (0.631)	−2.006*** (0.638)
Female education	−0.443*** (0.038)	−0.369*** (0.039)	−0.409*** (0.038)	−0.210*** (0.037)
Temperature	0.011 (0.009)	0.023*** (0.009)	0.032*** (0.009)	0.015* (0.009)
Precipitation (SPEI)	0.002 (0.004)	0.003 (0.003)	−0.000 (0.003)	0.002 (0.003)
Adjusted R^2	0.96	0.95	0.96	0.96
Number of grids/clusters	6677	6751	6751	6750
Observations (both panels)	100,006	101,089	101,074	101,074

Note: OLS-estimates reported. Dependent variable in Panel B=Mortality risk of children under the age of five. Grid- and year-fixed effects always included. Standard errors clustered at the grid-level in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

According to these back-of-the-envelope calculations, our estimates thus point to substantial annual increases in child mortality due to terrorist activity especially when the scale of escalation is substantial and long-lasting. To this effect, our findings also speak to the existing literature on the adverse consequences of large-scale conflict on child health.

Given that the direct impact of terrorism (in terms of its lethality and destruction of public health infrastructure) tends to be very small, we are reasonably confident that increases in child mortality primarily emerge through the behavioral response of economic agents (e.g., parents, doctors, medical staff, aid workers and policymakers) to terrorism. Exploring the role of several potential mediators in the terrorism-child mortality nexus, we show that higher levels of terrorist activity unfavorably correlate with several proximate causes of child mortality: the incidence of malaria and diarrhea, vaccination rates and malnourishment. Future work could examine these behavioral responses and mediators in more detail. For instance, it could be interesting to examine—using appropriate micro-level or survey data—whether it is parents, doctors, politicians or other economic agents that respond especially unfavorably (in terms of the consequences for child health) to terrorism.

Recent years saw encouraging advances in reducing child mortality in Africa. Our empirical analysis, however, suggests that terrorism produced some conspicuous setbacks with respect to this trend. Domestic and international policymakers are thus called upon to counter terrorism but should also consider mitigating behavioral responses to terrorism that are to the detriment of children's health, for example, through information and education campaigns that adjust perceptions about terrorism and the risk it entails.

ACKNOWLEDGMENTS

We would like to thank Daniel Arce, Janina Beiser-McGrath, Anke Hoeffler, Oguzhan Turkoglu as well as the participants of EPSA 2022, the Jan Tinbergen European Peace Science Conference 2022, the 2023 Annual Meeting of the European Public Choice Society and the MACIE seminar at the University of Marburg for their valuable feedback. The data used in this study are publicly available and no specific funding was acquired. The instructions to access the data and the code used in the analyses will be made available on Harvard's Dataverse.

Open Access funding enabled and organized by Projekt DEAL.

CONFLICT OF INTEREST STATEMENT

Both authors contributed equally to this work and declare no conflict of interests.

DATA AVAILABILITY STATEMENT

The data and the code used in the analyses will be made available on Harvard Dataverse.

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ENDNOTES

- ¹ Terrorism is “the premeditated use or threat to use violence against noncombatants by individuals or subnational groups to obtain a political objective through the intimidation of a large audience beyond that of the immediate victims” (Gaibullov & Sandler, 2019, p. 278).
- ² Furthermore, by highlighting the role of terrorism in child health and mortality, we also add to the larger empirical literature on the socio-economic consequences of terrorism (e.g., Tavares, 2004; Frey et al., 2007; Gaibullov & Sandler, 2011; Meierrieiks & Gries, 2013; Kim & Albert Kim, 2018; Blasco et al., 2022; for an overview see Gaibullov & Sandler, 2019).
- ³ Beside its unfavorable direct effects, child mortality may increase as a consequence of large-scale conflict because of the spread of infectious diseases (e.g., Charchuk et al., 2016; Iqbal & Zorn, 2010), in utero exposure to conflict (Akbulut-Yuksel, 2017; Aparicio Fenoll & González, 2021; Dagnelie et al., 2018), the destruction of health infrastructure and the flight of health workers from conflict-ridden areas (e.g., Chi et al., 2015; Chukwuma & Ekhat-Mobayode, 2019; McKay, 1998; Price & Bohara, 2013; Sharara & Kanj, 2014), the destruction of sanitation, waste and water treatment (Kirschner & Finaret, 2021), the underfunding of healthcare institutions by the government in times of conflict (Gates et al., 2012; Iqbal, 2006) and reduced food supply (e.g., Lin, 2022), which, in turn, is expected to correlate with weight loss and stunting (Bendavid et al., 2021; Bundervoet et al., 2009; Dunn, 2018; Kirschner & Finaret, 2021; Wagner et al., 2018, 2019). See also Kadir et al. (2019) for a literature review on the consequences of armed conflict for child health and development.
- ⁴ A common definition of armed civil conflict involves at least 25 (or, more conservatively, at least 1000) battle-related deaths per year in a specific country (Blattman & Miguel, 2010). The magnitude of violence associated with terrorism is commonly much smaller (Gaibullov & Sandler, 2019).
- ⁵ These countries and territories are Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, eSwatini, Ethiopia, Gabon, Gambia,

Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, South Sudan, Senegal, Sierra Leone, Somalia, Somaliland, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Western Sahara, Zambia and Zimbabwe.

- ⁶ The use of (self-reported) survey data to create the child mortality variable may lead to measurement error in this variable. As we use the child mortality variable as the dependent variable in our empirical analyses, we expect this potential measurement error to mainly affect the precision of our estimates but not to cause bias when estimating the effect of terrorism on this variable. Fortunately, since the number of observations available for our analyses is very large, this is anticipated to counteract losses of estimation precision due to measurement error in the dependent variable.
- ⁷ In contrast to the log trans-formation, the inverse hyperbolic sine transformation is also defined for grid-year observations with no terrorist activity (e.g., Burbidge et al., 1988; Bellemare & Wichman, 2020). Note that as part of our robustness checks, we also use alternative transformations and operationalizations of our terrorism index.
- ⁸ The GTD can be accessed at <https://www.start.umd.edu/gtd/>.
- ⁹ Allowing for further lags yields similar findings. Controlling for a maximum of 10 lags, the terrorism index will now longer share a statistically significant association with child mortality after the sixth lag. Note, however, that because a more complex lag structure reduces our sample size, these results cannot be directly compared to our other estimates reported in Table 1.
- ¹⁰ This overlap implies that while “terrorism may be used by rebel forces, terrorism need not be associated with civil war” (Gaibullov & Sandler, 2019, p. 291).
- ¹¹ We only examine the effect of terrorism on child mortality within the same grid cell. We consider (via the named standard errors) but do not explicitly operationalize spillover effects of terrorism in neighboring cells. Assessing the role of spatially indirect effects of terrorism on child mortality may be a fruitful avenue for future research.
- ¹² As a robustness check, we also construct the sup-*t* confidence bands of Montiel Olea and Plagborg-Møller (2019) which are especially appropriate when we are interested in the entire event-time path, that is, in implicitly testing multiple hypotheses at once (Freyaldenhoven et al., 2021). Reassuringly, these confidence bands are like those in Figure 4 to 6.
- ¹³ The data can be found at <https://population.un.org/wpp/>.
- ¹⁴ Both figures are averages over our observation period. Due to population growth, total births are substantially higher in 2017 compared to 2000, while the child mortality risk (e.g., due to medical advances) is considerably lower in 2017 compared to 2000.
- ¹⁵ All outcome measures are made available by the *Institute for Health Metrics and Evaluation* on their website <https://ghdx.healthdata.org/local-and-small-area-estimation>.
- ¹⁶ For instance, holding constant the number of terrorism casualties, such an increase would imply an increase of the Africa-wide absolute number of terrorist incidents by approximately 625. While such an escalation in violence is substantial, it was indeed observed for our sample between both 2011 and 2012 as well as between 2013 and 2014.
- ¹⁷ Yet, other causes of child mortality in this year were much more important. For instance, ca. 530,000 children died from malaria, ca. 425,000 from diarrhea, and ca. 600,000 from pneumonia in 2010 (Liu et al., 2012).

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How to cite this article: Meierrieks, D., & Schaub, M. (2024). Terrorism and child mortality. *Health Economics*, 33(1), 21–40. <https://doi.org/10.1002/hec.4757>