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RESEARCH NOTE

Contagion to unrest: Investigating the link between disease and civil unrest in Africa

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Abstract
Scholars, policymakers, and citizens alike remain invested in the impact of infectious diseases worldwide. Studies have found that emerging diseases and disease outbreaks burden global economies and public health goals. This article explores the potential link between measles outbreaks and various forms of civil unrest, such as demonstrations, riots, strikes, and other anti-government violence, in four central African countries from 1996 to 2005. Using a difference-in-differences model, we examine whether disease outbreaks have a discernible impact on the prevalence of civil unrest. While our findings indicate that the relationship between disease and civil unrest is not as strong as previously suggested, we identify a notable trend that warrants further investigation. These results have significant implications for health and policy officials in understanding the complex interplay between state fragility, civil unrest, and the spread of disease.

Keywords: disease; civil unrest; Africa; difference-in-differences

Introduction

The relationship between infectious diseases and civil unrest has been widely discussed in the academic literature, with scholars highlighting the potential negative impact of disease on citizens' relations with each other and with their government. In addition, conflicts can distract governments from allocating sufficient attention and resources to preventive disease programs. Existing research has predominantly relied on ordinary least squares models or process tracing to establish a causal link between disease and civil unrest (Barnett & Dutta, 2008). In contrast, this article aims to assess the robustness of this relationship by employing a difference-in-differences (DiD) approach to answer this question: does disease contribute to an increase in civil unrest?

Understanding the potential link between disease and civil unrest holds immense importance, especially for policymakers in developing countries. By identifying and addressing the potential connections, policymakers and scholars can gain insight into the factors driving civil unrest cycles in certain countries. Additionally, this understanding can guide the allocation of funds or aid to the public health sector in developing nations, potentially eliminating the root causes of civil unrest.

Past research has identified several possible ways in which disease can increase the likelihood of civil unrest. These include weakening social bonds, increasing power struggles, and undermining economies (Altman, 2010; Daw, 2021). Conversely, some scholars argue that while conflicts may exacerbate epidemics, they are unlikely to initiate them. However, disease outbreaks could ignite civil unrest. Other

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studies have explored the broader relationship between disease and national security, encompassing civil unrest and human rights concerns (Peterson & Shellman, 2006). This research has found that disease rates can indirectly impact civil unrest by influencing the sociopolitical institutions of the state, exacerbating economic inequalities, eroding social institutions such as family and education, and undermining democratic political structures, making conflict management more challenging bureaucratically (Peterson & Shellman, 2006).

The literature has predominantly explored the idea that conflict may promote disease outbreaks (Desta, 2018). Scholars argue that conflict can trigger mass population movements, leading to overcrowding, lack of clean drinking water, poor sanitation, destruction of health infrastructure, and poor nutritional status (Connolly & Heymann, 2002; Daw, 2021). These factors contribute to an imbalance in the human-microbe relationship, leading to a resurgence of preventable infectious diseases as health care systems become overwhelmed and unable to sustain existing disease control programs (Goniewicz et al., 2021).

This article employs a DiD model to investigate the potential reverse relationship between disease outbreaks and civil unrest. Focusing on four bordering states in central sub-Saharan Africa that were exposed to a measles outbreak in 2001, our study covers the period from 1996 to 2005, including five years before and after the treatment. By taking this approach, we aim to shed light on the potential link between civil unrest and infectious disease and its implications for policymakers in developing countries. Figure 1 illustrates the change in measles cases and the spike in 2001 in the treated group.

The remainder of this article is structured as follows: We begin by providing an overview of measles as a disease, highlighting its significance as a case study. Next, we outline our research design, utilizing the DiD model to explore the relationship between disease outbreaks and civil unrest. We present our findings and engage in a discussion, identifying specific cases where measles appeared as a precursor to civil unrest. Finally, we conclude by emphasizing the importance of further research to examine the connections between infectious diseases, including measles, and civil unrest, considering the ongoing rise of such diseases.

Measles

The history of measles dates to the ninth century, but it was not recognized as a viral disease until 1911. Since then, it has garnered significant attention from the medical community, culminating in the licensing of a vaccine in the United States in 1963 (Centers for Disease Control and Prevention, 2020). Measles is

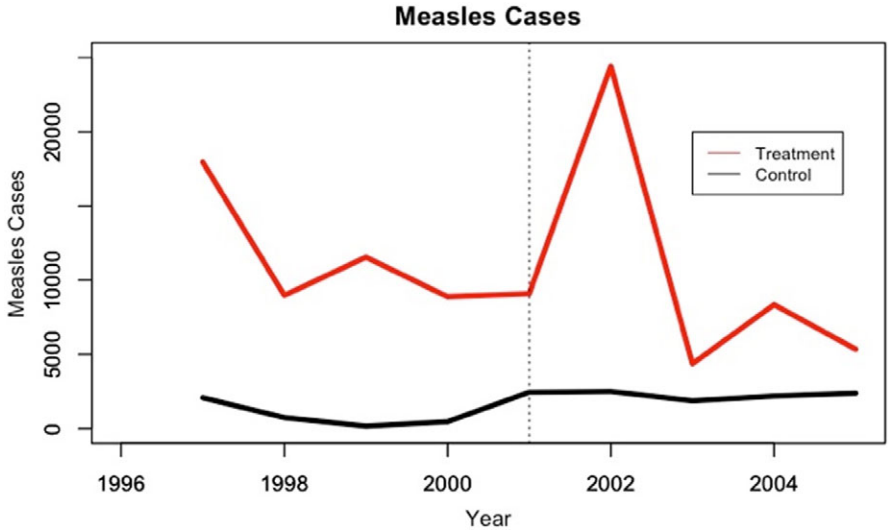

Figure 1. Plot of measles cases. The treatment year is 2001. The treatment group includes Chad and Cameroon, and the control group includes the Central African Republic and the Congo.

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highly contagious, with a basic reproductive number of 12–18, indicating that each infected person can transmit the disease to 12 to 18 additional people, leading to rapid and extensive transmission (Laksono et al., 2016). Given the large and sudden spikes in cases that it can cause, measles serves as an ideal case study for understanding the relationship between disease outbreaks and civil unrest.

Other characteristics of measles also make it a valuable case study. The disease generates lifelong immunity, preventing reinfection within communities and allowing for more accurate data for analysis. Additionally, its eradicable nature, achieved in many Western countries through vaccination, presents advantages for the research design as it further prevents the data from being skewed by constant reinfections. Despite its eradicable nature, measles remains a significant health concern in some regions, including the Democratic Republic of the Congo (referred to as the Congo), and it has been underrepresented in security frameworks because of its absence in Western industrialized countries (Fenollar & Mediannikov, 2018; Youde, 2010).

Drawing parallels with COVID-19, measles shares some similarities in terms of manifestations and risk factors, such as fever, cough, and pneumonia (James et al., 2021). There is even evidence suggesting that immunity against measles may offer some protection against COVID-19 (Peng et al., 2022). Both viral genomes consist of single-stranded ribonucleic acid (RNA),[1] making their replication processes similar. Additionally, both are transmissible through air particles (e.g., from coughing or sneezing), although measles remains more infectious than COVID-19 (R0 of 18 and 2.5, respectively) (Wilder-Smith, 2021).[2] However, both diseases have epidemic potential and can spread through populations rapidly, especially in areas with low vaccination rates. Given the pandemic in 2020, studying measles can provide insights that may be relevant and extendable to our understanding of COVID-19. There are, however, key differences. For example, measles has a higher mortality rate than COVID-19, at 30% compared to 3.5%. Measles primarily affects children, and severe cases are more common among young children and infants. In contrast, COVID-19 affects individuals of all age groups, with older adults and individuals with underlying health conditions being at higher risk of severe illness. Measles outbreaks also occur more rapidly and result in explosive outbreaks in susceptible populations, whereas COVID-19 transmission, while highly contagious, can be slowed or controlled through public health measures such as social distancing and mask-wearing.

Factors shaping civil unrest

Factors that can affect civil unrest in countries are multifaceted and can vary depending on the specific context. One factor that can contribute to civil unrest is the economic context, including inequality and poverty. High levels of poverty and income inequality can create social tensions and grievances, leading to protests and demonstrations (Korkmaz et al., 2016). Unemployment levels and food prices are also important economic factors that can contribute to civil unrest (Kollias & Tzeremes, 2022). When people face economic hardships and perceive a lack of opportunities, they may become more prone to participating in protests and social upheaval.

Political factors also play a role in civil unrest. Injustice, corruption, and lack of political freedom can fuel discontent and mobilize people to take part in protests (Braha, 2012). For example, when a government restricts political freedoms such as freedom of speech, assembly, or the press, it limits the avenues through which citizens can express their opinions and influence decision-making, which can manifest in civil unrest as people seek to reclaim their rights and demand more democratic governance. Significant policy changes, whether enacted domestically or imposed internationally, can directly affect the lives and livelihoods of the population. For instance, austerity measures, trade agreements, or social welfare reforms can have substantial economic and social consequences (Korkmaz et al., 2016). When

[1]RNA is a coding molecule that gets translated into protein. In this case, the viral RNA encodes for the protein components that make up the virus.

[2]R0 is used in epidemiology to quantify the transmissibility of infectious diseases. It measures how contagious a disease is and provides an estimate of its potential for spreading within a population. A disease with an R0 of 18 means that, on average, each infected person will transmit the disease to 18 others.

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these policies negatively impact a large portion of the population, that can trigger civil unrest as people protest what they perceive as detrimental changes to their well-being. In response to civil unrest, some governments may resort to repressive tactics such as excessive use of force, censorship, arrests, or human rights abuses. These measures can further aggravate tensions and escalate the level of civil unrest as citizens who witness or experience such repression may become more determined to protest against the government's actions.

Overall, civil unrest is a multifaceted phenomenon influenced by a diverse array of factors that exhibit significant variations across countries and contexts. The interplay and varying intensity of these factors contribute to the dynamics of civil unrest in specific cases. This relationship, characterized by complexity, often involves feedback loops and intricate interactions, whereby the influence of one factor on another and vice versa can create a web of interconnected causal relationships, making it challenging to isolate individual drivers of unrest.

Research design

In recent years, various linear regressions have been conducted to examine the relationship between civil unrest and disease, recognizing that the factors influencing civil unrest can be diverse and context dependent. Some scholars have used instrumental variables to address endogeneity concerns (Youde, 2010), while others have employed process tracing (Price-Smith, 2007). We contribute to this body of literature by adopting a DiD design as an empirical strategy to investigate the potential relationship between disease outbreaks and civil unrest, particularly focusing on measles, in Chad, Cameroon, the Central African Republic, and the Congo. These countries were selected because of their geographic proximity and similar contextual conditions, shown in Figure 2. The DiD accounts for time-invariant variables within our temporal range from 1996 to 2005. Given the time range of 10 years across four countries, our sample size for the model with a lagged variable is $N = 32$.[3]

DiD is a statistical method used to estimate the causal effect of an intervention or treatment by comparing changes in outcomes over time between a treatment group exposed to an intervention and a control group that is not exposed. The key idea is that the treatment group experiences a change in conditions as a result of the intervention, while the control group does not. The analysis compares the outcomes for both groups before and after the introduction of the intervention while implicitly controlling for time-invariant variables that do not change during this time frame. To apply DiD, it is essential to assemble two distinct groups: a control group comprising subjects unexposed to a measles outbreak and a treatment group consisting of subjects who were exposed to the outbreak. Additionally, data for both groups are required, covering the periods before and after the outbreak occurred (Visconti, 2022).

To implement the DiD design, we identify a treatment group of countries exposed to a measles outbreak in the year 2001 (Chad and Cameroon) and a control group of countries that did not experience such an outbreak (Central African Republic and Congo). Data from the World Health Organization on measles cases at the country level are used to identify a measles outbreak. We define a measles outbreak as a country experiencing more than two standard deviations above the mean number of cases in the prior five years. This criterion ensures statistical significance at the $p < .05$ level. Measles is an ideal disease for studying the relationship between disease and civil unrest because of its high infectivity, which allows for identification of clear spikes in cases in a relatively small time frame. The geographic distribution of countries belonging to the treatment and control groups is depicted in Figure 2. We use this definition as there is no standard outbreak definition, as differing disease spread rates and severity make it difficult for

[3]The sample size for a DiD analysis is calculated based on the number of groups (control and treatment) and the number of time periods before and after the treatment is introduced. In our case, we multiply the number of treatment groups (2 countries) by the number of control groups (2 countries) and then multiply that by the number of time periods before the treatment (5 years) and after the treatment (4 years). The sample size is thus *2 (treatment groups) * 2 (control groups) * (5 pre-treatment years + 4 post-treatment years).* Therefore, we have 36 individual observations, or units, across the four countries and the 10-year time period. We then subtract 4 (4 countries across 1 time period) due to the lagged dependent variable, so our final sample size is $N = 32$.

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Figure 2. Map of countries used in the study.

epidemiologists to determine a standardized number. Outbreaks are generally defined as an increase in disease relative to previous years (Reintjes & Zanuzdana, 2009).

The Social Conflict Analysis Database is employed to measure civil unrest, encompassing organized demonstrations, spontaneous demonstrations, organized riots, strikes, and other forms of anti-government violence (Salehyan et al., 2012). The total number of events per year in each country is aggregated based on these instances. We use a lagged dependent variable of civil unrest in our model to account for the time delay between disease outbreaks and civil unrest. For instance, it may take time for a disease outbreak to lead to civil unrest as the population may initially respond with preventive measures such as vaccination or social distancing. Similarly, the disease may need time to sufficiently disrupt the sociopolitical context and trigger unrest. By incorporating the lagged variable, the analysis can better identify and understand the potential link between measles outbreaks and civil unrest. Equation 1 serves as the analytical tool to estimate the effect of measles on civil unrest across countries, with each country-year serving as the unit of observation.

$$Total\ Conflict_{it} = \alpha + \beta_1(Treated)_{it} + \beta_2(Time)_{it} + \beta_3(DiD)_{it} + \varepsilon_{it} \quad (1)$$

Total conflict is the outcome variable of interest, representing the amount of civil unrest in country *i* during time period *t*. In this equation, α represents the constant term, or the baseline level of civil unrest

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Table 1. Regression output

	Civil Unrest
Treatment Group	–1.875 (1.049)
Time	1.775 (0.996)
Interaction (DiD)	–0.125(1.408)
Constant	4.125 (0.742)
N	32
R^2	0.494
Adjusted R^2	0.385
Residual Std. Error (df = 14)	1.484
F Statistic (df = 3; 14)	4.550*

$^{+}$ p <.1; * p < .05
Notes: The dependent variable is civil unrest, and the treatment is a measles outbreak. The sample size of 32 includes 18 units in the treatment and 18 units in the control minus 4 units for the lagged variable.

when all other variables in the equation are equal to zero. β_1 measures the effect of a measles outbreak on civil unrest, quantifying how much the dependent variable changes when there is a measles outbreak via $(Treated)_{it}$, which is a binary indicator variable equal to 1 if country *i* is in the treatment group that was exposed to a measles outbreak during time period *t*, and 0 otherwise.

β_2 is the coefficient associated with the difference in the outcome between the treatment and control group *before* a measles outbreak (the treatment). $(Time)_{it}$ accounts for potential time variations in civil unrest across all countries and periods. β_3 is the key parameter of interest as it captures the effect of a measles outbreak on civil unrest after accounting for both within and between-group differences, capturing the differential effect of the treatment. $(DiD)_{it}$ is the interaction term between the treatment indicator and time, capturing the differential effect of a measles outbreak on civil unrest. We do not include additional country-level control variables as the DiD model takes into account unit-level time-invariant effects like democracy levels and gross domestic product. Based on theory from prior literature, we expect that as measles cases increase, so does the level of civil unrest, which would be shown by a significant, positive coefficient for β_3.

Results

Table 1 shows the regression results from a two-tailed test. Our key estimate of interest, β_3, the interaction term or DiD, indicates a decrease in civil unrest of –.125, which corresponds to a reduction in civil unrest of less than one instance and is not statistically significant.

Figure 3 provides a visual representation of these results, showing the changes in measles and civil unrest from 1996 to 2005 in the countries under analysis. This plot serves two purposes. First, it visually demonstrates that the parallel trends assumption is met, as both the exposed and control groups follow a common trend until the treatment year.[4] Before 2001, the treated and control groups exhibit similar trends, with both groups experiencing comparable increases and decreases in civil unrest. However, there is a deviation in civil unrest levels between the treated and control groups after the measles outbreak, with the control group experiencing a greater increase in civil unrest. Second, it suggests that there is likely a weak relationship between civil unrest and measles, contrary to prior research.

These results are surprising, given prior literature suggesting that disease outbreaks lead to increased civil unrest. However, one explanation for this discrepancy is that disease outbreaks can cause people to adopt social distancing measures, such as staying at home to avoid getting sick. This fear of infection may

[4]DiD rests on the parallel trends assumption that, in the absence of exposure to a measles outbreak in 2001, the trends in outcomes for both the treatment and control groups would exhibit parallel trends across time.

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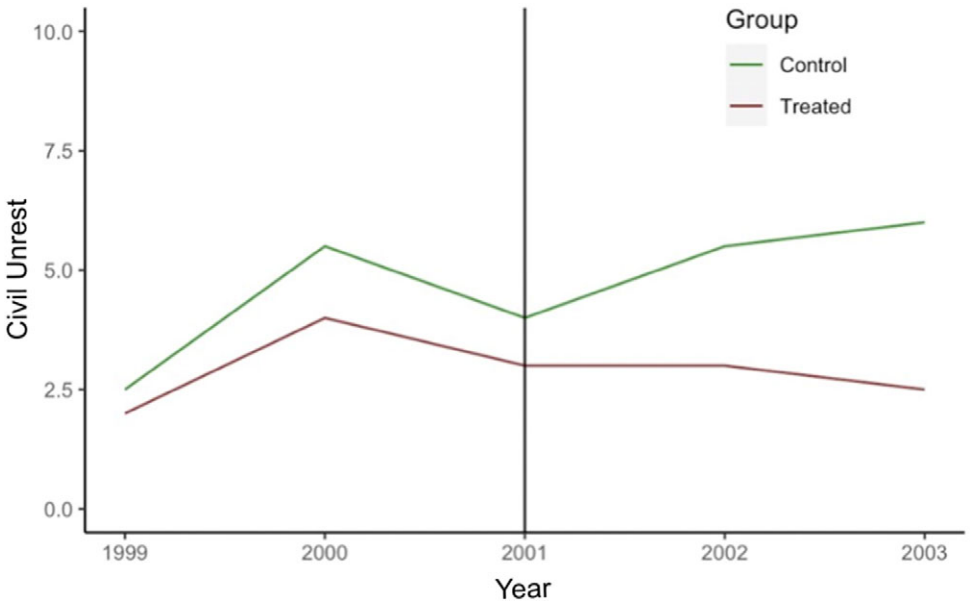

Figure 3. Parallel trends plot showing civil unrest across time. The treatment year is 2001. The treatment group includes Chad and Cameroon, and the control group includes the Central African Republic and the Congo.

lead to a decrease in social contact, which, in turn, could result in reduced tensions and a lower likelihood of conflict escalating. However, this hypothesis requires further exploration in future studies. The rapid increase in technology may also play a role in shaping the relationship between disease outbreaks and civil unrest. Technology serves as a tool for communication and information sharing during disease outbreaks (Tang et al., 2018). It enables government agencies to disseminate real-time updates and guidance to wider audiences. This communication between citizens and the government, and the ability to keep in contact with friends and family while social distancing, could mitigate the relationship between disease and civil unrest.

Overall, our findings show a weak relationship between measles outbreaks and a *decrease* in civil unrest. These results contribute to the ongoing debate on the relationship between disease and civil unrest, emphasizing the need for further research to fully comprehend the mechanisms underlying this relationship.

Regional examples

In light of our study's results, it is important to recognize the limitations of using national-level disease data when examining the relationship between disease and civil unrest. Analyzing this relationship at a national scale may overlook important dynamics that occur at the community or regional level. To address this limitation, we look at three regional cases of measles outbreaks in African communities, focusing on instances that occurred within three years of the treatment year of 2001 used in the DiD. This sample includes outbreaks in Maputo, Mozambique, in 1998; Niamey, Niger, in 2003; and Bangui, Central African Republic, in 2000. For each case, we collect data at the community level on the incidence of civil unrest over a six-year period, including two years before the measles outbreak, the outbreak year, and three years after the outbreak.

Figure 4 provides a graphical representation of the incidence of civil unrest in each region across the time period just before, during, and after the occurrence of a measles outbreak, similar to the DiD. The analysis reveals a slight overall increase in conflict after the outbreak, but significant heterogeneity is

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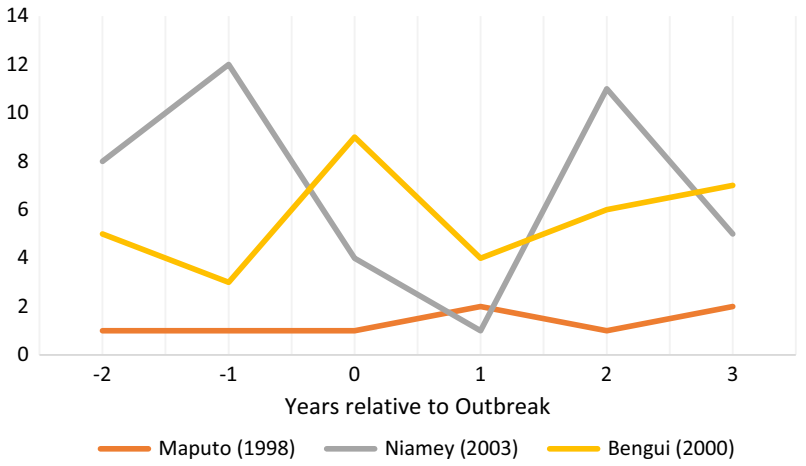

Figure 4. Plot of conflict over time in regions that experienced a measles outbreak.

observed within these cases. For example, Niamey experienced a sharp decline in civil unrest during and one-year after the outbreak, while Bangui experienced an increase in civil unrest during the outbreak. These differences among cases suggest a more complex relationship between disease and civil unrest.

Apart from the outbreak's severity, several other compounding factors could contribute to the variation in results throughout these cases. Regions with different medical capabilities may better contain or treat outbreaks, leading to lower mortality rates, which would reduce the risk of civil unrest. The type of disease may also play a role; it would be interesting to examine trends for diseases with lower infectivity but higher mortality rates, such as Ebola, in comparison to measles. Additionally, government responses to outbreaks could impact potential increases in civil unrest. If civil unrest is already present, quarantine or curfew orders may be met with resistance, exacerbating the spread of disease and further straining the relationship between the government and the public.

Furthermore, the ability to observe relationships between disease and civil unrest may be hindered by individual governments underreporting measles cases. Previous studies have found that outbreaks are often underreported, leading to data limitations. For instance, in the Maputo City outbreak, health facilities failed to report 82% of the observed cases (Jani et al., 2006). As a result, caution should be exercised when interpreting the findings of studies that rely on national-level disease data to infer a causal relationship between disease and civil unrest. However, this would not significantly change our results, as the outcome variable of civil unrest would remain the same and 2001 would remain the treatment year since the values of outbreak would increase across the entire time period.

Discussion

Our findings deviate from prior scholarship that has suggested causal links exist between disease outbreak and civil unrest. Based on our study, we find that more investigation of this relationship is needed. Despite the lack of a significant, direct relationship in our null finding, disease prevention should remain a critical priority for policymakers to improve global public health and well-being. We suggest that policymakers should adopt a more nuanced approach to disease prevention, civil unrest, and conflict management, taking into account the specific contexts in which disease outbreaks occur. Researchers should continue to explore alternative analytical methods, such as the DiD approach used in our study, to gain a deeper understanding of the intricate interplay between disease and civil unrest.

Our study highlights the advantages of using a DiD model, which better incorporates contextual factors compared to the linear models used in previous studies. However, it is essential to recognize that our study still has limitations, as it examines only one disease and a small sample of countries.

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Nevertheless, it serves as a starting point for reigniting the exploration of the complex relationship between disease and civil unrest.

Identifying and understanding the specific compounding factors that shape the relationship between conflict and civil unrest will be crucial for effective prevention of both. For example, our investigation into regional-level outbreaks reveals that disease can correlate with both an immediate increase and a delayed increase in civil unrest post outbreak. Investigating the factors that lead to volatile combinations of civil unrest and disease will aid the implementation of appropriate countermeasures. By delving into these complexities, policymakers can better address the intertwined challenges of disease and civil unrest in their efforts to promote peace and global health.

Future research should therefore focus on expanding the sample size to include more diseases and countries to gain a better understanding of the relationship between disease and civil unrest as more data become available—particularly since our null results could be the result of low statistical power, given the limited number of cases. Additionally, further investigation into the contextual factors that may influence the relationship between disease and civil unrest is needed. These factors may include the severity of the outbreak, existing social movements, and government response, which may play a role in the level of conflict observed during and after an outbreak occurs. For example, developing nations tend to have increased levels of civil unrest compared to developed nations. Future research could also use more granular data on disease incidence and civil unrest at the community level to improve accuracy in evaluating the relationship between them. Revisiting this model in the coming years will be of utmost importance as the incidence of infectious diseases such as measles is on the rise across Africa. This is primarily due to the anti-vax movement and the COVID-19 pandemic weakening health infrastructure in the region (Aborode et al., 2021; Gouandjika-Vasilache et al., 2006). As reporting for both disease and civil unrest continue to improve, it may be possible to better evaluate the relationship between them in the coming years.

Furthermore, continued research into the relationship between disease and civil unrest is critical for understanding how to prevent and address both public health and security issues. As the world faces new challenges following the COVID-19 pandemic and the resurgence of previously controlled diseases, understanding the complexities of these relationships will be increasingly important for policymakers and practitioners. With the majority of resources from health infrastructure in many countries being put toward COVID-19, diseases that were once almost eradicated, like measles, are now resurfacing.

Finally, this research contributes to the broader field of security studies and international relations by highlighting the interconnectedness of health and security. It underscores the importance of considering health issues as integral components of security agendas. The findings of this research, suggesting that the relationship between conflict and disease may not be as strong as previously believed, may inform future research and policy discussions on the intersection of health, conflict, and international security as there remains a trending relationship that warrants further investigation. Further research investigating the relationship between disease and civil unrest is crucial for policymakers and health officials as it can inform strategies to address state fragility, civil unrest, and the spread of disease. By recognizing the potential disruptions in surveillance and response systems during disease outbreaks, policymakers can develop more effective measures to mitigate the impact of both civil unrest and disease on public health and security.

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