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Research Article

To what extent do we learn from past epidemics: a mobile phone survey of selected villages in Liberia

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Background

Epidemics remain a major threat, impacting lives around the globe. We ask whether and to what extent individuals learn from past epidemics in Liberia, a country affected by both the 2014-2016 Ebola Virus Disease and COVID-19.

Methods

We explored the association between being exposed to the 2014–2016 Ebola epidemic and measures of beliefs, intentions, and behavior during COVID-19. We interviewed 600 respondents three times over seven years, sampled by an initial list of 2,265 respondents in 571 villages across all of Liberia selected through Random Digit Dialing (RDD) in 2015-2016. We used an Ordinary Least Square (OLS) model, controlling for county fixed effects and a set of socio-demographic and economic covariates.

Results

Because of the selection among individuals with mobile phones, most respondents were male, educated, and were more likely to be from urban areas and wealthy. They were, on average, 33.9 (SD=10.4) years old, 66% were Catholic, and only 23% were unemployed. 22.8% of respondents reported that they knew someone in their community who got or was suspected of having Ebola; 13.7% were exposed to COVID-19, while 4.5% were exposed to both epidemics. We found that those exposed to Ebola were less likely to have wrong beliefs about the virus and how to cure it; they were also more likely to state that they would go to the health facility for important needs such as birth delivery and child routine vaccination; and, they were more likely to get vaccinated during COVID-19. The findings are primarily driven by individuals with low trust in the government.

Conclusions

This research suggests that individuals who experience a previous epidemic learned from it and might be more responsive to correct information and better respond to a future one. This has policy implications for patient education and awareness campaigns during the next epidemic.

In the twenty-first century, we witnessed several infectious disease outbreaks, including the 2003 Severe Acute Respiratory Syndrome (SARS), the 2009 swine flu, the 2012 Middle East Respiratory Syndrome (MERS), the 2014–2016 Ebola virus disease in West Africa, the 2015 Zika virus, and not least the COVID-19 pandemic, with its devastating impacts on lives.[1] A future pandemic seems inevitable, with the risk of infectious diseases being more and more likely over time.[2] Leading causes of climate change, such as deforestation, urbanization, and livestock husbandry required for meat production, bring more and more animals into closer contact with humans. This increases the likelihood of pathogens jumping from animals to humans.[3]

There has been an active debate on what governments have learned from past epidemics to have acted better during COVID-19.[4] This includes genetic sequencing of pathogens and sharing sequence data in global databases to strengthen the capacity to identify and respond to outbreaks; developing technologies for vaccines, diagnostic testing, and therapeutics; training health workers; and, more generally, strengthening health systems. However, even though much of the preparedness burden for the next epidemic lies in the hands of health institutions, the public can also play a vital role.

We explore whether and to what extent individuals have learned from a past epidemic, in Liberia. Like many other African countries, Liberia is still characterized by poor

health infrastructure and mistrust in state institutions, making it one of the most vulnerable countries in the world to infectious diseases. From 1989 to 2003, the country experienced two civil wars, shattering the strained relationship between Liberian citizens and their government. Liberia was then affected by an Ebola outbreak between March 2014 and May 2015, and it also experienced COVID-19 starting in March 2020.

This study aims to investigate the association between being exposed to the 2014–2016 Ebola epidemic and measures of beliefs, intentions, and behavior during COVID-19, in the country of Liberia.

METHODS

STUDY LOCATION

Liberia is among the poorest and least developed countries in the world, ranking 178 out of 191 countries in terms of the Human Development Index. After decades of civil wars that ended in 2003, the country has been characterized by a low level of trust in the government and weak institutions.[5] When the second civil war ended in 2003, few Liberian citizens trusted the government.[6] A decade later, another threat to trust came in the form of the Ebola epidemic which hit the country in March 2014. The Government of Liberia (GOL) responded with social mobilization, case management, treatment and surveillance, water sanitation, and hygiene activities. The Ministry of Health (MOH) led relief efforts supported by several international institutions. After a first wave of Ebola was quickly contained by April, the disease had spread to the capital city, Monrovia, by the end of June 2014, and, by August 2014, the situation was out of control. The GOL urgently called on the international community for a massive response: 62 countries committed US$2.3 billion to respond to the epidemic in West Africa, including US$806 million to Liberia.[7] By the end of the epidemic, 10,675 confirmed, probable, or suspected cases were recorded, while the cumulative number of deaths reached 4,809–the highest number in West Africa.[8] In terms of COVID-19, the first case appeared in March 2020. As of the end of 2023, more than 8,000 cases and 290 deaths were recorded in Liberia. 77.2% of the population received at least one dose of COVID-19 vaccine.[9]

STUDY DESIGN AND PARTICIPANTS

Phone numbers from 2,265 respondents in 571 villages across all of Liberia were selected through Random Digit Dialing (RDD) in 2015-2016. These respondents were then interviewed through a combination of an Interactive Voice Response (IVR) survey and a mobile phone survey conducted by a local non-governmental organization (NGO). The first round of data collection was conducted between November 2015 and January 2016.[10] A local survey research firm was provided with the original list of phone numbers and aimed to interview respondents a second and a third time during COVID-19, between October 13 and November 9, 2020, and March 18 and April 4, 2022, respectively. Because of the budget constraints, the firm only spent about one month trying to recontact up to 1,000 respondents.

Our analysis sample focuses on the same 600 individuals who were interviewed three times over the seven-year study period. Since the original selection approach through RDD was random,[10] this sub-sample of respondents is similar to the original full sample of 2,265 individuals in terms of socio-demographic characteristics. However, by construction, the original full sample consisted of individuals with mobile phones. Thus, this sample is not representative of the Liberian population overall. More information on the sample can be found below and in Table 1.

DATA COLLECTION

Our survey tools were modelled based on internally validated surveys across countries such as Afrobarometer and Demographic Health Surveys, and piloted in Liberia. The survey tool for the first data collection (2015–2016) asked about respondents' socio-demographic and household characteristics, migration, trust and political preferences, Ebola-related questions including knowledge, self-reported incidence, and information received, as well as experience with the response and perceptions around responsibilities. The survey tools for the second and third data collections were kept as close as possible to the first one, for comparability, but added COVID-19-related questions instead of Ebola-related ones. Similar to the previous survey tools, we included questions on knowledge, self-reported incidence, and information received, as well as experience with the response and perceptions around responsibilities. In addition, we asked about beliefs, intentions, and behaviors, as explained next.

STUDY OUTCOMES

We investigated how individuals exposed to the 2014-2016 Ebola epidemic changed the following measure of beliefs, intentions, and behaviors during COVID-19 (Table 2):

1. Common (wrong) ***Beliefs*** in Liberia during the COVID-19 epidemic: The key outcomes include — whether individuals cannot reduce the risk of getting COVID-19 by washing hands with soap and avoiding touching the face; whether people with O+ blood can catch COVID-19; whether strong African drinks can kill COVID-19; whether you can get COVID-19 only by direct contact with Chinese people; whether local medicines can heal you if you get COVID-19. All the beliefs individuals were asked about in the survey were chosen with input from the local team and related to the major existing rumors in the country at that point in time. We also gathered data on whether individuals thought Ebola was not real, believing the government only wanted more foreign money, a common wrong belief that spread during the 2014-2016 Ebola epidemic.
2. Stated ***Intentions:*** The key outcomes include — whether they would seek care or recommend seeking care for a sick child with fever; for a child in need of routine vaccination; for pregnant women to deliver

Table 1. Socio-demographics for the 600 respondents in the analysis sample

	Mean	Standard Deviation	Min	Max
Characteristics of respondent				
Lives in urban area	70.5	45.6	0	100
Male	75.3	43.1	0	100
Language English	5.17	22.2	0	100
Age	33.9	10.4	18	79
Household size	7.21	3.69	0	20
Education				
Resp educ none	5.50	22.8	0	100
Resp educ primary	5.83	23.5	0	100
Resp educ secondary	58.7	49.3	0	100
Resp educ university	30	45.9	0	100
Occupation				
Resp work for wage	22.8	42.0	0	100
Resp self-emp	36.2	48.1	0	100
Resp professional	4.33	20.4	0	100
Resp not working	22.5	41.8	0	100
Resp other occupation	14.2	34.9	0	100
Religion				
Resp has no religion	0.50	7.06	0	100
Resp is Catholic	66.3	47.3	0	100
Resp is Protestant	20.8	40.6	0	100
Resp is Muslim	8.50	27.9	0	100
Resp has other religion	1.50	12.2	0	100
Wealth				
Income last month (USD)	114.3	212.8	0	2400
Has electricity	40.7	49.2	0	100
Has radio	81.3	39.0	0	100
Has tv	26	43.9	0	100
Has mobile phone	96.3	18.8	0	100
Has bank account	27	44.4	0	100
Has refrigerator	8	27.2	0	100
Has vehicle	19.8	39.9	0	100

Notes: The table describes mean, standard deviation, minimum and maximum of the socio-demographic characteristics for the 600 respondents in the analysis sample.

at the health facility; if not vaccinated for COVID-19, whether they would be willing to receive the vaccine.

3. ***Behavior:*** The key outcomes include — whether they or anyone in the household delayed or skipped a needed health visit; whether they took any protective measures in the previous 7 days in terms of hygiene or avoiding contact; and whether they got vaccinated for COVID-19. In the analysis of behavior, specifically, we only reported protective measures mentioned by more than 10% of the sample. However, the survey tool collected several measures on hygiene or avoiding contact. The former set of measures included washing hands for 20 seconds or more with soap, using hand sanitizers, wearing face masks, and wearing disposable gloves. The latter set of measures included avoiding large gatherings or long queues; avoiding public transportation; avoiding shaking hands or kissing on cheeks; avoiding touching the face; keeping a safe distance from people outside one's household; staying at home as much as possible; protecting the elderly from physical contact with children in the household.

STATISTICAL ANALYSIS

We used an Ordinary Least Square (OLS) model to estimate the association between being exposed to the 2014–2016 Ebola epidemic and the measure of beliefs, intentions, and behavior during COVID-19. Exposure to the epidemic is defined as a self-reported survey measure of any friend,

Table 2. Outcomes for the 600 respondents in the analysis sample

Panel A: (Wrong) Beliefs	Mean (%)	Standard Deviation
Any wrong belief	37.8	48.5
Wash hands	7.17	25.8
Blood transmission	16.7	37.3
African drinks	18	38.5
Chinese people	7.17	25.8
Local medicines	5.17	22.2
Ebola real	9	28.6
Panel B: Intentions		
Child fever	95.7	20.4
Child routine vaccine	95.5	20.7
Birth delivery	98	14.0
COVID-19 vaccine	72.4	44.8
Panel C: Behavior		
Skip visit	15.9	36.6
Wash hands	87.3	33.3
Use sanitizer	21.8	41.3
Use face masks	77	42.1
Avoid gatherings	28.3	45.1
Avoid shaking hands	15.8	36.5
Social distancing	11	31.3
COVID-19 Vaccinated	61.8	48.6

Notes: The table describes mean and standard deviation of the main outcomes (beliefs, intentions, and behavior) for the 600 respondents in the analysis sample.

neighbor, family member, or other people that the respondent personally knew in the community getting or being suspected of the disease. To remove time-invariant observable differences, the model controls for county fixed effects and the following set of covariates: 1) socio-demographic factors: urban; male, primary education, age, married, household size, main language being English, Muslim; 2) economic factors: wealth index constructed based on assets, livestock and household characteristics as in Demographic Health Surveys (2013), occupation as being self-employed, for wage or not working; whether they lost a job during Ebola; distance to the capital city. Results are robust to adding other controls or other combinations of covariates. Standard errors are clustered at the village level.

RESULTS

SOCIO DEMOGRAPHICS

Most respondents are male (75%), educated (59% have at least secondary education, 30% have some university level education), and were more likely to be from urban areas and wealthy, as defined by ownership of assets and household characteristics. This is not surprising since males, more educated, and wealthy individuals living in urban areas are more likely to own phones.[11] Respondents were, on average, 33.9 (SD=10.4) years old at the time of the first data collection. 66% were Catholic and 21% Protestant. While 23% were unemployed, 36% were self-employed, and 23% were formally employed. 22.8% of respondents reported that they knew someone in their community who got or was suspected of having Ebola; 13.7% were exposed to COVID-19, while 4.5% were exposed to both epidemics.

KEY FINDINGS

BELIEFS

Individuals who reported exposure to Ebola were less likely to have wrong beliefs: respondents were less likely to report that Ebola was not real (Estimated coefficient (est)=0.050, Standard Error (SE) = 0.023 95% Confidence Interval (CI): -0.096;-0.04) and that local medicines can heal you if you get COVID-19 (est=0.032, SE=0.019 95% CI: -0.070;0.005) (Figure 1. Panel A). We did not find statistically significant associations for the other beliefs.

INTENTIONS

Those who reported exposure to Ebola were more likely to have their child brought immediately to the health facility for routine vaccination (est=0.041, SE=0.025 95% CI: -0.008;0.089), and to recommend pregnant women for childbirth (est=0.024, SE=0.007 95% CI: 0.010; 0.039) (Figure 1. Panel B). We did not find statistically significant associations when asked about bringing a child with fever immediately to the health facility or being willing to get the COVID-19 vaccine.

BEHAVIOR

Respondents exposed to Ebola were more likely to get vaccinated against COVID-19 (est=0.077, SE=0.041 95% CI: -0.003; 0.157) (Figure 1. Panel C). We did not find statistically significant associations when exploring other measures of behavior.

All these findings are, however, primarily driven by individuals with low trust in the government (Figure 1. Panel D.), suggesting that exposure to epidemics could push these individuals to change their beliefs, intentions, and behavior more than individuals with high trust.

DISCUSSION

In this study, we found that individuals exposed to Ebola were less likely to have wrong beliefs about the virus and how to cure it; they were also more likely to state that they would go to the health facility for important needs such as birth delivery and routine child vaccination; and they were more likely to get vaccinated during COVID-19. The findings are primarily driven by individuals with lower trust in the government.

While there is some evidence that experience with natural hazards and low trust in state authorities are the primary factors shaping risk perception during a crisis, and thus compliance with desired social behavior,[12] evidence about past health epidemics is limited. Trust in the govern-

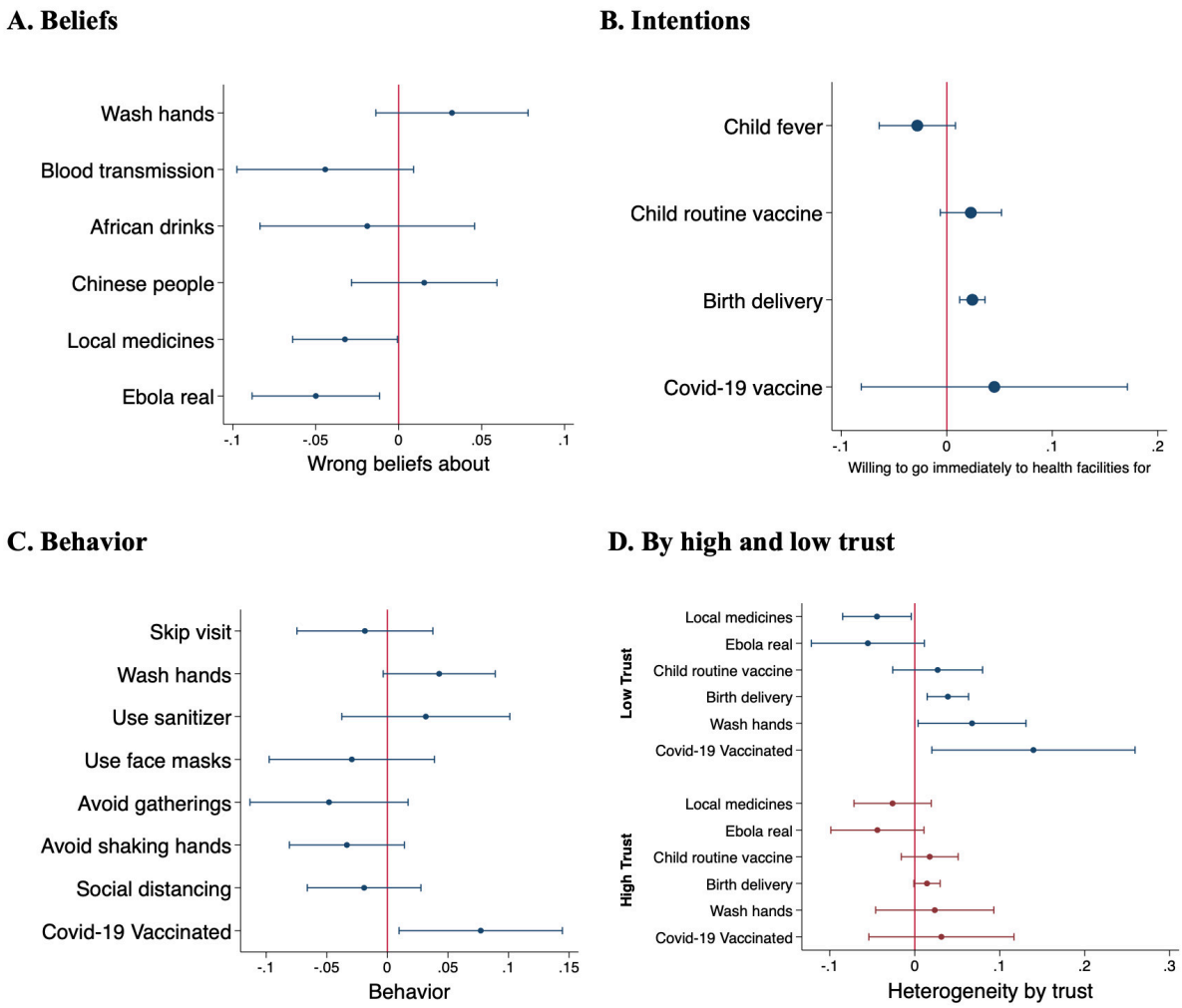

Figure 1. Regression coefficients of the association between being exposed to Ebola and outcomes during COVID-19:

Notes: The table shows the regression coefficients (percentage point change) of the association between being exposed to Ebola and the following outcomes during COVID-19: Panel A. Beliefs; Panel B. Intentions; Panel C. Behavior; Panel D. All outcomes by low or high level of trust in the government, defined by median. The number of observations is n=600. Error bars represent 95% confidence intervals.

ment has been associated with the utilization of care during the Ebola epidemic in Liberia[13] and the Democratic Republic of Congo.[14] Similarly, lack of trust and information created a significant barrier to controlling the disease.[13,15] Yet, not much is known about how exposure to past epidemics affects beliefs, intentions, and behavior in the next one, and how this varies by level of trust in the government.

This research suggests that individuals who experienced a previous epidemic learned from it and might be more responsive to correct information and better respond to a future one. This has policy implications for patient education and awareness campaigns during the next epidemic. Strategies entailing targeting of affected individuals to boost changes in behavior or take advantage of survivors to lead examples and curb the next epidemic[16] are some suggestions for governments deriving from our analysis. It is also worth noting that results were primarily driven by individuals with lower levels of trust in the government, implying that exposure to an epidemic could lead to a positive change for this subset of individuals, who are often of concern for low uptake and compliance with policies.[13]

This research is not without limitations. Since the first data collection happened during the Ebola epidemic, the sample was drawn from individuals who owned a mobile phone. This makes the sample not representative of the entire population of Liberia. The analysis is also limited to the country of Liberia and the exposure to the Ebola and COVID-19 epidemics. Finally, the analysis uses survey data that may be subject to reporting biases, and it explores associations without isolating the causal impacts. Given all these weaknesses, we need more research to understand whether these findings would hold to a representative sample of the population of Liberia or populations in other low-income countries. More importantly, more comprehensive (mixed-methods) research should investigate to what extent these learnings can be generalizable when exposed to other epidemics or how they could be reinforced when exposed to multiple ones.

While the results are encouraging, the extent to which exposure to an epidemic changed beliefs, intentions, or behavior was not universal. However, the results were primarily driven by individuals with lower levels of trust in the government. This was true even when exposed to an epidemic like Ebola, where the fatality rate and misinformation were much higher than COVID-19, and in a country such as Liberia with a historically low level of trust in the government. As low trust in the government was one of the primary factors associated with believing misinformation[14, 17] and lower compliance with policies,[13] this finding highlights that exposure to an epidemic might be, to some extent, beneficial for this group of individuals.

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DATA AVAILABILITY

Data are available on request.

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AUTHORSHIP CONTRIBUTIONS

EM: Conceptualization, analysis, writing. DY: data curation and writing.

DISCLOSURE OF INTEREST

The authors completed the ICMJE Disclosure of Interest Form (available upon request from the corresponding author) and disclosed no relevant interests.

ADDITIONAL MATERIAL

The article contains one Table in the Online Supplementary Document.

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