Research Notes

Covid-19 vs. Ebola: Impact on households and small businesses in North Kivu, Democratic Republic of Congo

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ABSTRACT

In April 2020, the Eastern Democratic Republic of Congo was facing two major infectious disease outbreaks: Covid-19 and Ebola Virus Disease (EVD). We highlight large differences in the socioeconomic impact of these two outbreaks. The data come from a phone survey that we conducted in the period May-July 2020 with 637 households and 363 small firms from a megacity and two rural communes in the province of North Kivu. While 3,470 EVD cases and 2,287 EVD deaths were confirmed since August 2018, self-reported impacts of EVD on revenues, access to food and behavior were limited. In contrast, only 251 Covid-19 cases were reported as of July 22nd but respondents reported sizable effects on livelihoods, especially in the large urban hub, and in part driven by substantial job losses. Our results show that different infectious disease outbreaks can have very different effects, largely unrelated to case numbers of the disease. Moderately lethal but highly transmissible viruses such as Covid-19 can trigger a steep economic downturn, especially in areas with high economic interconnectedness, reflecting both national and international policies to contain the pandemic.

1. Introduction

Over the last decades, the frequency of emerging infectious disease (EID) outbreaks has been steadily accelerating and represents a growing threat to the global economy (Jones et al., 2008; Morens and Fauci, 2013; Smith et al., 2014). Zoonoses, infectious diseases originating from wildlife, represent 60% of known EID and grow at the fastest rate. As the world was trying to contain the 2020 Covid-19 outbreak, the Eastern Democratic Republic of Congo (DRC) faced the additional challenge of tackling another zoonosis simultaneously: the Ebola Virus Disease (EVD, Zaire strain).

Focusing on DRC's North Kivu province, we study the socioeconomic impact of Covid-19, and how it compares to that of EVD. EID differ by their virologic features, notably regarding case fatality rates and transmissibility, which translate into different public health policies and socio-economic impact. The literature on the cost of diseases distinguishes between the direct economic effects of the disease (mainly health sector costs related to patient treatment), and the indirect costs stemming from disease containment policies (e.g. quarantine, school closure, contact tracing) and behavioral responses (e.g. contagion avoidance behavior, consumption and investment postponement) (Bloom, 2018; Smith et al., 2019). For highly transmissible diseases, the indirect impact can be a multi-fold of the direct costs, unrelated to the actual number of cases (Beutels et al., 2009; Bowles et al., 2016; Keogh-Brown & Smith, 2008; Smith et al., 2019; Thomas et al., 2015).

The aforementioned studies have linked the socioeconomic impact of a disease to its specific virologic features, for one disease at a time. Instead, we compare the socioeconomic impact across two high-profile disease outbreaks that affected North Kivu simultaneously. To do so, we rely on phone interviews with a sample of 1,000 households and entrepreneurs. So far, most estimates on the impact of Covid-19 relied on simulation models based on existing datasets (e.g. Gerson Mahler et al., 2020; Laborde et al., 2020; Sumner et al., 2020), but there are ongoing efforts to collect micro-level data, mainly through phone interviews (e.g. Abebe et al., 2020; Farzana & Amrita, 2020; World Bank, 2020). We contribute to these efforts in order to better understand the economic impact, and do so in the context of North Kivu in DRC, a country, which – according to the simulated estimates so far – will be among the worst affected by Covid-19 (Gerson Mahler et al., 2020), and is likely to become a prime zoonoses hotspot (Morse et al., 2012).

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2. Context

2.1. North Kivu

North Kivu is one of DRC's most eastern provinces, bordering neighboring countries Uganda and Rwanda. It spans almost 60,000 km² and counts about 7 million people, of which 40% live in urban areas (CAID, 2020). The survey focuses on three distinct areas: Goma, Rutshuru and Mutwanga. Goma is the provincial capital and the largest city in North Kivu, with an estimated two million inhabitants (INS, 2017). Rutshuru is a rural territory north of Goma. It is composed of a main town, Rutshuru city (approx. 80,0000), and several villages. Mutwanga is a commune located in the northeastern territory of Beni and counts around 45,000 inhabitants (Interview with Chief, personal communication, March 2019) (Fig. 1).

North Kivu was the epicenter of the first and second Congo war (1996–1997 and 1998–2003). Despite the 2003 formal peace agreement, it is still home to almost 100 different armed groups (KST, 2020a). The armed groups fight for control over resources (such as minerals, timber and charcoal), but also extort civilians at roadblocks and kidnap for ransom. In May 2020, the month in which we started our interviews, Kivu Security Tracker counted 46 clashes between armed groups, 56 violent deaths among civilians, 16 abductions and 9 kidnappings for ransom, for South and North Kivu combined (KST, 2020a). At the start of the year, in January 2020, the province counted 1.7 million internally displaced people, of which the majority is staying with host families (UNHCR, 2020a).

In the rural areas of North Kivu, the vast majority of the population live from agriculture and livestock raising (CAID, 2020). Mining is among the most important off-farm income sources, and considerably adds to state revenue (Geenen et al., forthcoming; World Bank, 2016). Both for farm and non-farm products, (informal) cross-border trade is critically important. For instance, more than 50,000 people cross the border each day at the Gisenyi-Goma One Stop Border Post (Mercy Corps, 2019b), while there are also many crossings at the 765-km long porous borders with Uganda (Ilunga Kalenga et al., 2019).

The population in North Kivu is overwhelmingly young, with approximately 48% below 15 years old (INS, 2017). Poverty and food insecurity are widespread. It is estimated that 60% of North Kivu's Population live under the international $1.9 poverty line (World Bank, 2016). The province's health infrastructure is inadequate: there is a density of only 1 doctor per 15,529 inhabitants; and the child mortality rate in 2012 was 131 per 1,000 live births (INS, 2017). Only 5% of households has access to piped water into their dwelling or yard, 60% has access to another improved water source, while 35% rely on unimproved sources for their drinking water (unprotected wells, springs or surface water) (INS, 2014). The lack of access to water is a particular problem in the City of Goma with its long queues at crowded communal taps, and where 70% of the population does not have access to a clean water source within a 30 min roundtrip, increasing the challenge of disease containment (Mercy Corps, 2019a).

The most common diseases in North Kivu are malaria, respiratory infections and diarrheal diseases (CAID, 2020). Outbreaks of measles, cholera and yellow fever repeatedly occur (Arie, 2019; Ilunga Kalenga et al., 2019).

2.2. EVD and Covid-19

The EVD outbreak was declared on August 1st 2018. In the course of two years, it spread across 29 health zones, including 19 in North Kivu, 9 in Ituri and 1 in South Kivu. Most cases were
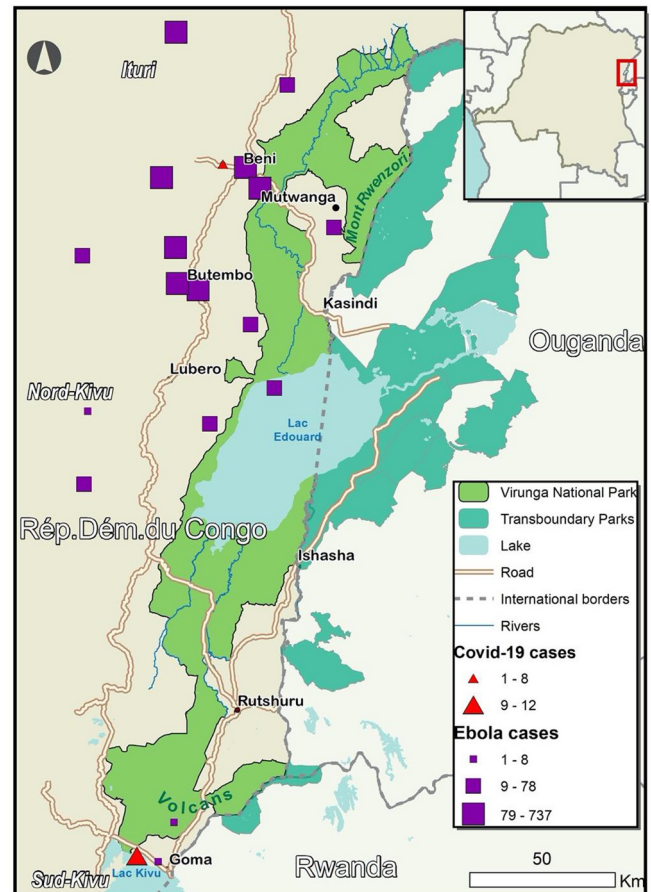

Fig. 1. Displays the spatial spread of EVD (purple) and Covid-19 (red) cases in Eastern DRC by health zone. The spatially disaggregated data on EVD and Covid-19 were obtained from the World Health Organization (2020c) and the North Kivu provincial ministry of health (2020), respectively. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

however recorded in and around the cities of Beni and Butembo. The 2018–20 EVD outbreak was declared to be over on 25 June 2020; 3,470 cases were confirmed, causing the death of 2,287 people (MSF, 2020). These numbers make this tenth EVD outbreak in DRC the second largest in the world, only surpassed by the 2013–16 outbreak in West Africa.

Covid-19 first emerged in Wuhan, China, at the end of 2019. A first case within DRC was detected in Kinshasa (DRC's capital) on March 10, 2020, and a first case in North Kivu on March 30, 2020 (Radio Okapi, 2020a). As of 22 July 2020, the month in which our data-collection ended, there were 251 confirmed cases in North-Kivu and, given the case fatality ratio of 2.29% at the moment, an estimated 7 death (UNICEF, 2020). Fig. 1 shows the spatial distribution of EVD and Covid-19 in North Kivu by the end of our data-collection period.

There are multiple virologic differences between EVD and Covid-19. Transmissibility is the most important one from an economic cost perspective. Whereas Covid-19 is highly transmissible, EVD is only moderately so. The difference in transmissibility mainly stems from three underlying differences. First, while EVD transmission occurs mainly through direct, close and prolonged contact with blood, secretions or other bodily fluids of an acutely ill or deceased EVD patient, Covid-19 can spread much more indirectly, through small respiratory droplets transmitted from a distance, and by touching contaminated objects and surfaces (Dean et al., 2016; WHO, 2020a, 2020b). Second, while almost 30% of

EVD-infected individuals are asymptomatic (Dean et al., 2016), they usually are not contagious until they develop symptoms (WHO, 2020a). In contrast, the majority of Covid-19 cases are asymptomatic *and* infectious (WHO, 2020b). Third, EVD is more lethal. While the latest WHO situation update reports a Covid-19 case fatality ratio of 2.6% in the DRC (WHO, 2020d), the 2018–2020 EVD outbreak in eastern Congo had a case fatality rate of 66% (WHO, 2020c). As a result, EVD often kills its host before others can be infected.

These differences drive the basic reproduction number (R_0) or the expected number of cases an infected person will cause, on average, during their infectious period in absence of control measures. R_0 fluctuates around 1.5 for EVD[1], but attains about 3 to 4 according to the first estimates for Covid-19[2]. Furthermore, the effective reproduction number (R_e), or the number of cases an infected person effectively causes (in the presence of control measures), can be reduced more easily for EVD because of its easily detectable symptoms at an early stage, and because avoiding close contact with bodily fluids is more straightforward than avoiding contact with airborne respiratory droplets (Mizumoto et al., 2019). EVD's R_e can be brought down even more since the development of the highly effective rVSV-ZEBOV-GP EVD vaccine which was used for the first time towards the end of the 2014–16 West-African outbreak, and again in the recent DR Congo outbreak, where it was 97.5% effective at stopping EVD transmission, relative to no vaccination (WHO, 2019).

Because of EVD's moderate transmissibility, the spread of the 2018–20 outbreak could be contained to a limited geographic area. Containment measures included real-time epidemiologic surveillance, testing, contact tracing, ring vaccination, provision of safe and dignified burials, and systematic screening of 177 million travelers at 80 points of entry – yet borders remained open the entire time (Ilunga Kalenga et al., 2019; WHO, 2020c).

In contrast, Covid-19 quickly evolved into a pandemic, despite drastic containment measures worldwide. Covid-19 reached North Kivu relatively late however, after the spike of Covid-19 infections in Italy, thus allowing for early preparedness. Furthermore, EVD screening points were still active and allowed to detect people with fever. Additional measures included border closings with Rwanda and Uganda on March 22 and 23, as well as a lockdown of cities from April 6 to 20 (UNHCR, 2020b). A second lockdown was decided on May 19 for another two weeks after seven new cases were reported in North Kivu (Radio Okapi, 2020b). As part of the lockdowns, churches and restaurants were closed, maximum occupancy in public transport was decreased and non-essential shops were closed. Beyond these local and regional measures, the global economic slow-down caused by Covid-19 led to a decrease in the demand for and prices of minerals – the primary export goods of DRC; a depreciation of the Congolese franc (−8% since 01/01/2020); and an increase in the price of basic necessities (+5% to 88% on March 26, shortly after the closing of borders) (KST, 2020b).

3. Sample & survey

We present results based on phone surveys conducted in the period May-July 2020. Our sample consists of 1,000 respondents, representing 637 households and 363 small businesses in Goma,

Table 1
Breakdown of the sample, by location and respondent type.

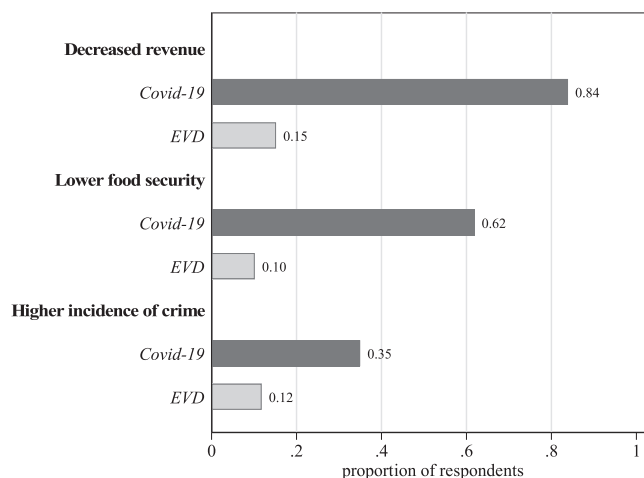|	Household	SME	Total
Goma	212	99	311
Mutwanga	425	75	500
Rutshuru	0	189	189
Total	637	363	1,000

Fig. 2. Self-reported impact of Covid-19 vs EVD in the full sample.

Mutwanga and Rutshuru. Table 1 provides a breakdown by location and respondent type. The respondents in Goma and Mutwanga (81% of the current sample) were selected in 2019, in the framework of a research project on the impact of electricity provision in rural and urban communities nearby Virunga national park.[3] At that time we conducted a full census of households and businesses in the town of Mutwanga and 12 neighborhoods of Goma. We then drew a stratified random sample, oversampling respondents that were more likely to get connected to the electricity grid. Appendix 1 provides detailed information on the sample and presents descriptive statistics. Relying on the construction quality of houses as a proxy for wealth, we show that its distribution in the sample roughly follows that of the census. However, households and businesses in the best quality housing are overrepresented while those in the poorest quality housing are underrepresented. The respondents in Rutshuru (19% of the current sample) are representative of the small businesses connected to Virunga's electricity grid in the area of Rutshuru. Compared to the rest of the population, business owners are on average somewhat younger, higher educated and wealthier (Appendix 1).

The surveys consisted of a number of simple questions regarding the impact of Covid-19 and EVD.[4] First, we presented the respondents with the following potential consequences of Covid-19 and asked whether they applied to them or their household: 1) decreased revenue in economic activity; 2) more difficulties to satisfy food requirements; 3) faced a higher incidence of criminality. Respondents were then asked to answer these same questions, with

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[1] R_0 was estimated at 1.8 during the 1995 outbreak in Congo, at 1.3 during the 2000 outbreak in Uganda and at 1.5 for Guinea, 1.4 for Sierra Leone and 1.9 for Liberia during the 2014 outbreak in West-Africa (Althaus, 2014; Chowell et al., 2004; Khan et al., 2015).

[2] Sanche et al. (2020) estimate R_0 at 5.7 for the outbreak in Wuhan, China, but research in Brazil and Europe arrives at estimates in the 3 to 4 range (Flaxman et al., 2020; Mellan et al., 2020).
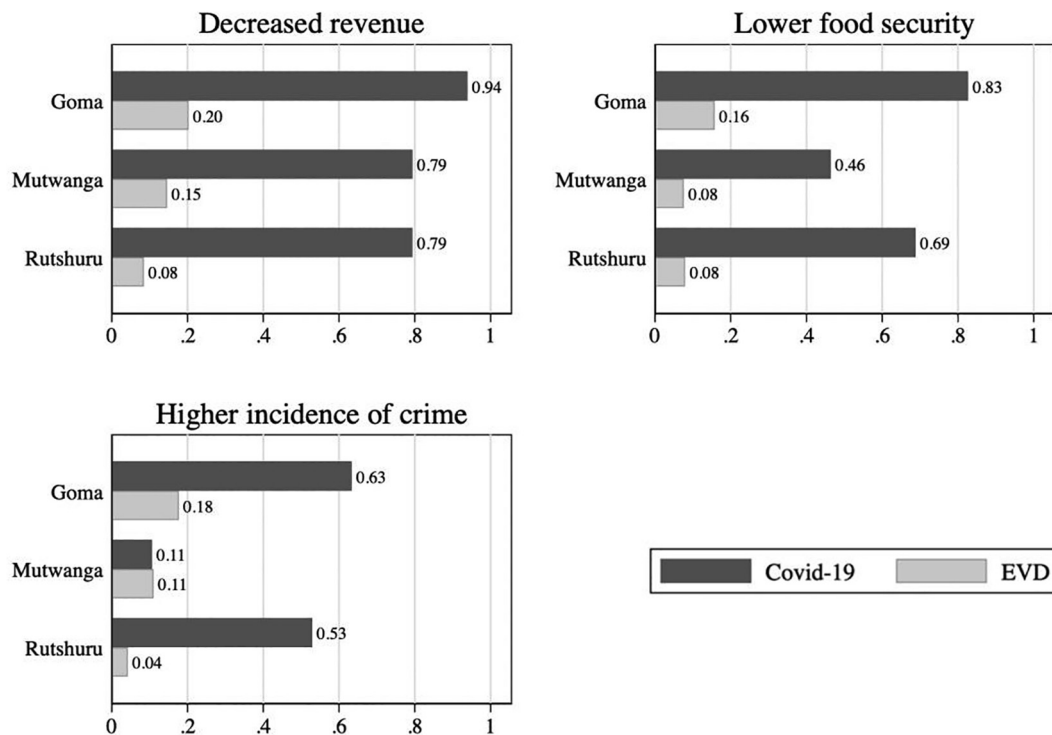
[3] For more information, see https://www.uantwerpen.be/en/research-groups/iob/projects/powering-development.

[4] The surveys were conducted within the framework of a research project that received ethical clearance from the Ethics Committee for the Social Sciences and Humanities at the University of Antwerp. Explicit verbal consent was sought from the respondents and they were informed of their right not to participate or not to answer certain questions. Information allowing the identification of participants was stored separately and will only be consulted in the event of a follow-up survey. Appendix 2 presents the survey questions.

Fig. 3. Self-reported impact of Covid-19 vs EVD by location. The horizontal axis indicates the proportion of respondents.

regards to EVD. Second, we asked them about behavioral changes in response to Covid-19 and EVD. The questions were taken from Vinck et al. (2019) and asked whether respondents: 1) avoided visiting family members; 2) avoided visiting neighbors; 3) avoided taking public transport; 4) avoided going to markets; 5) avoided going to churches; 6) stayed home more often than usual; 7) avoided shaking hands to greet people; and 8) washed their hands more frequently. Third, we asked respondents to assess their likelihood of contracting Covid-19. Answer categories were 1) very unlikely; 2) unlikely; 3) don't know; 4) likely; 5) very likely. Finally, for the subset of SMEs in Goma and Rutshuru, we asked how many workers they had to fire because of Covid-19.

4. Results

4.1. Livelihoods

The self-reported impact of Covid-19 on livelihoods strongly exceeds that of EVD (Fig. 2). While 84% of respondents report a decreased revenue due to Covid-19, only 15% indicates that EVD had such an effect. Moreover, 62% of respondents report that Covid-19 has caused difficulties to satisfy their food requirements, while for EVD this was only the case for 10%. One third of respondents (35%) further link Covid-19 to a higher incidence of criminality, while only 12% report such an effect for EVD.

The revenue decline likely relates in part to job losses. We find that 37% of the SMEs surveyed in Goma and Rutshuru report having fired employees since the start of Covid-19. These employees represent 47% of the permanent staff and 40% of daily workers of the affected SMEs. 15% of the SMEs in Goma and Rutshuru declared having stopped their activities temporarily. Small shops, restaurants and bars were, unsurprisingly, most affected.

It is further interesting to note that – whether talking about revenue, food security or crime – the share of respondents that reports an impact of either Covid-19 or EVD is higher in Goma than in Mutwanga and Rutshuru (Fig. 3). This likely relates to the high popula-
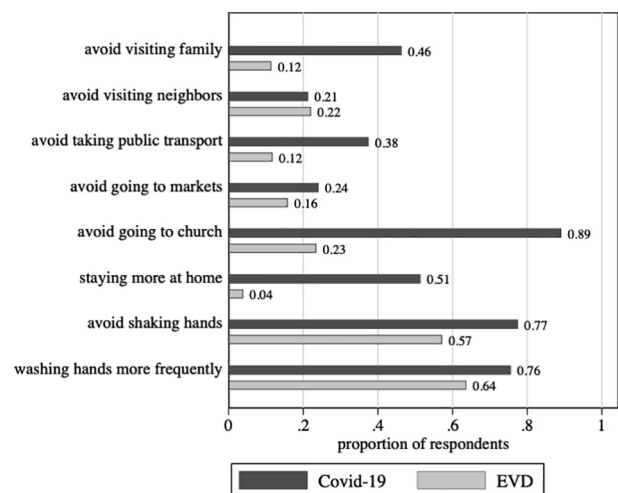

Fig. 4. Self-reported behavioral change due to Covid-19 vs EVD in the full sample.

tion density of Goma, leading to more stringent lockdown measures – but may also reflect its high economic interconnectedness, both in terms of cross-border trade and its own vibrant service sector. The differences between Goma and the rural areas of Mutwanga and Rutshuru are both statistically [5]and economically significant. Appendix 3 further shows that the differences between Covid-19 and EVD hold within the subsamples of households and SMEs, and within the groups of respondents that are connected to the Virunga Energies grid and those that are not. Moreover, they also

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[5] Results from a *t*-test indicate that the share of respondents indicating to be affected by Covid-19 or EVD is significantly higher in Goma than in the rural areas of Mutwanga and Rutshuru, with p-values below 0.01 for each of the three outcomes (decreased revenue; lower food security and higher incidence of crime).
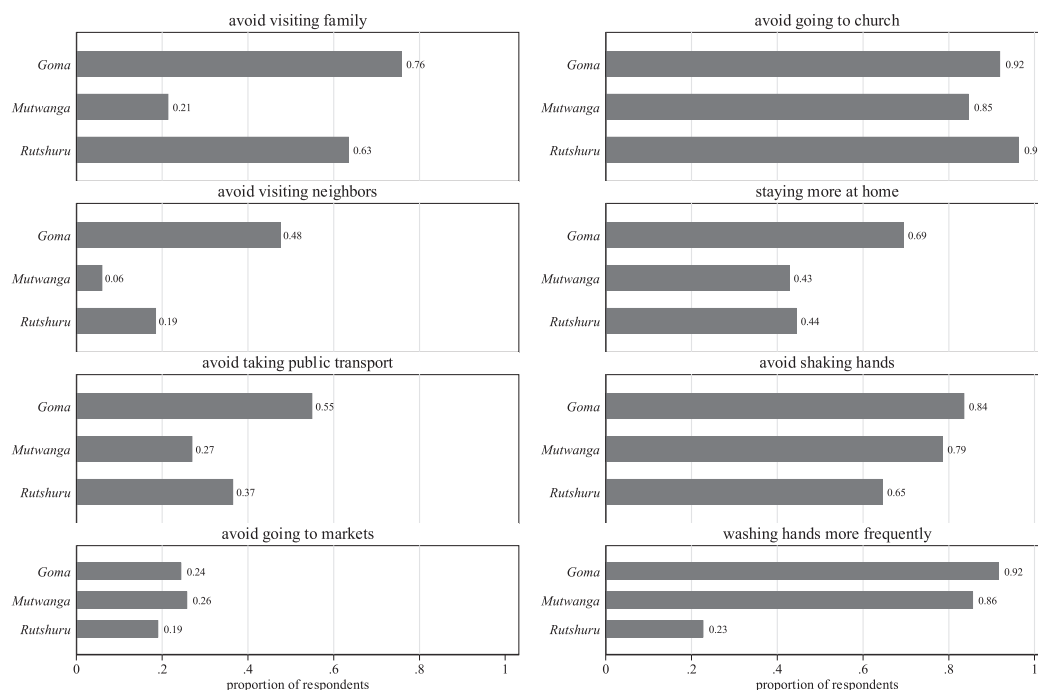
Fig. 5. Self-reported behavioral change due to Covid-19 by location.

hold within two subsamples that are underrepresented in our sample: the poorest and least educated households.

4.2. Behavior and risk

Respondents also report that Covid-19 had a much stronger impact on their behavior than EVD[6]: a multifold of respondents indicate to avoid visiting family, taking public transport, going to markets or churches and to stay more at home than usual (Fig. 4). Only when it comes to visiting neighbors and shaking and washing hands, the difference between Covid-19 and EVD is less pronounced. Overall, the behavioral changes related to Covid-19 are strongest in Goma (Fig. 5). This may reflect the more stringent policy responses to Covid-19 in urban areas, but probably also relates to the fact that respondents in Goma indicate a higher likelihood of contracting Covid-19. While 39% of respondents in Goma consider the Covid-19 infection risk likely or very likely, this is only the case for 11% in Mutwanga and 26% in Rutshuru (Fig. 6).

5. Discussion and concluding remarks

Outbreaks of EID are a growing threat to humanity and the global economy (Jones et al., 2008; Morens and Fauci, 2013; Smith et al., 2014). To deal with this threat, more knowledge is needed on how EID affects different societies and economies. Transferring lessons learned from one epidemic or pandemic to the other needs to be done carefully however, as impacts can vary drastically (e.g. Barro et al., 2020; Correia et al., 2020).

The latter point is illustrated in this paper: we find that the impact of Covid-19 on the economy and (food) security in North Kivu is much higher than that of EVD, although the number of Covid-19 cases and therefore its direct economic cost remain much lower. The much higher indirect impact of Covid-19 is largely due to its higher transmissibility, which led to drastic containment
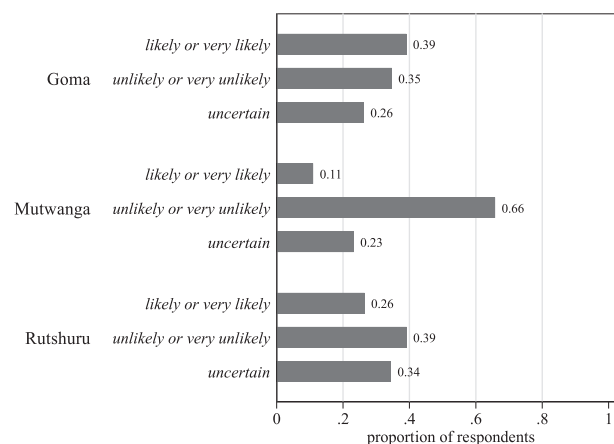

Fig. 6. Self-reported likelihood of contracting Covid-19.

measures, and a quick global spread of the disease, further exacerbating its economic impact through economic interconnectedness. That (economic) interconnectedness exacerbates the impact of Covid-19 is also illustrated by the differential impact that we detected across megacity Goma and more remote Mutwanga and Rutshuru. Job losses were one part of the impact pathway. Another pathway, documented elsewhere (KST, 2020b) is a rapid surge in the prices of basic necessities.

Two limitations of our study should be highlighted. First, the sample was drawn for another research project and underrepresents the poorest and least educated individuals, while clients of the Virunga electricity network are overrepresented. We show however that the differential impact of Covid-19 and EVD holds within a large range of subsamples, including the poorest and least educated households and those that do not have an electricity connection. Second, at the time of the survey, the EVD outbreak was almost under control whereas Covid-19 cases were rising. We can-

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[6] We acknowledge that self-reported behavioral changes do not necessarily reflect actual changes in behavior.

not exclude that the timeline of the two outbreaks may have affected respondent's perceived impact.

Simulations of the Covid-19 impact find DR Congo to be among the three countries most at risk for worsening food insecurity (WFP, 2020), and with the largest estimated increase in the number of poor (Gerson Mahler et al., 2020). Our findings corroborate these gloomy predictions. Besides the immediate socioeconomic cost that we observe today, there will likely be severe persistent effects of school dropouts, lower food intake during early childhood, interrupted vaccination campaigns, and likely also of a slow recovery in revenues from remittances and resource exports. In addition, and as already suggested by our findings on the self-reported incidence of criminality, by fueling the ranks of the un(der)employed, the Covid-19 crisis could further prolong and intensify instability in the region.

In the short run, policymakers should try to mitigate the downturn by devising targeted and context-specific public health measures, by scaling up income support and cash transfer programs, ensuring stable food supplies, and securing sustained learning for all children. In the longer term, the crisis could lead to a more fundamental rethinking, of disease contagion measures but also of economies, their interconnectedness, vulnerabilities and resilience. Future research should inform this rethinking and can do so by drawing on the large variation of the pandemic's impact, both across and within countries.

CRediT authorship contribution statement

Nik Stoop: Conceptualization, Data curation, Formal analysis, Writing - original draft. **Sébastien Desbureaux:** Conceptualization, Data curation, Writing - original draft. **Audacieux Kaota:** Conceptualization, Data curation. **Elie Lunanga:** Conceptualization, Data curation. **Marijke Verpoorten:** Conceptualization, Data curation, Writing - original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.worlddev.2020.105352.

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