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The COVID-19 pandemic is deepening the health crisis in South Kivu, Democratic Republic of Congo

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ABSTRACT

Objective: The outbreak of coronavirus disease 2019 (COVID-19) in South Kivu, Democratic Republic of Congo raised concerns regarding additional morbidity and mortality. Updating these indicators before a second wave is essential in order to prepare for additional help.
Methods: From mid-May to mid-December 2020, weekly surveys were undertaken in sampled streets from 10 health areas to quantify the use of barrier measures, and interview pedestrians about sickness and deaths in their households. Crude death rates (CDRs) were estimated.
Results: Minimal use or no use of face masks was observed in at least half of the streets. From May to December 2020, the number of suspected cases of COVID-19 increased six-fold ($P < 0.05$). Of deaths within 30 days preceding the interviews, 20% were considered to be related to COVID-19. The monthly CDRs at the beginning and end of the study were approximately 5 and 25 per 1000 population, respectively ($P < 0.05$); that is, annual CDRs of 60 and 260 per 1000 population, respectively. Thus, during the first wave, the estimated mortality rate increased by 50% compared with previous years, and increased at least four-fold by the end of 2020.
Conclusion: Despite possible overestimations, the excess mortality in South Kivu is extremely concerning. This crisis calls for a rapid response and increased humanitarian assistance.

Introduction

The health status of the population of South Kivu, an eastern province of Democratic Republic of Congo (DRC), has been and remains under extensive epidemiological surveillance, including mandatory reporting of all cases of major infections (Ebola, cholera, malaria, etc.) in each health zone. This monitoring enables

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rapid public health alerts (e.g. outbreaks of Ebola in 2019 and cholera in 2020), and has been further activated since the onset of the coronavirus disease 2019 (COVID-19) pandemic (Organisation mondiale de la Santé – Democratic Republic of Congo, 2020). Nevertheless, the characteristics of this region – namely limited resources and armed conflict – induced uncertainties about the use of hospital services, individual health behaviours and essential epidemiological indicators (i.e. morbidity and mortality) during the COVID-19 pandemic (Jarrett et al., 2020). Beyond monitoring cases of various endemic and epidemic infectious diseases, including COVID-19, estimation of population morbidity and mortality enables more appropriate responses to be made to the health crisis.

In May 2020, the 'DashboardCovidRDC' team (Wimba et al., 2020) initiated a household health survey, including adherence to barrier measures, in the urban area of Bukavu and its surroundings in South Kivu. Data collection continued after the first wave (Spring 2020). Analysis of data and trends over the last 8 months of 2020 is likely to shed light on the most recent health status of the population, and update morbidity and mortality data before a potential second wave (Engelbrecht and Scholes, 2021).

Materials and methods

Study setting and design

In South Kivu (population approximately 6 million), each health zone is a well-defined geographical entity (maximum dimension 150 km) located within the limits of an administrative territory of at least 100,000 inhabitants with somewhat homogeneous sociocultural communities. Each health zone is divided into health areas of approximately 10,000 inhabitants.

This descriptive, weekly cross-sectional study was carried out in Bukavu and its surroundings (approximately 900,000 inhabitants). This represented three of 34 health zones in South Kivu. Within these three health zones, 10 representative health areas (total 319,245 inhabitants) were selected for this survey.

Data collection

Between mid-May and mid-December 2020, a survey was conducted each week by 20 trained interviewers. A pilot phase was undertaken between 14 and 21 May 2020, initiated by Université Officielle de Bukavu, and these results were published in August 2020 (Wimba et al., 2020). Between 17 June and 10 July 2020, the university continued data collection for 4 additional weeks; subsequently, from 2 August to 15 December 2020, the same methodology was applied by investigators supervised by a private partner (Archidiocèse de Bukavu, 2020).

The questionnaire and survey method have been described elsewhere (Wimba et al., 2020). Briefly, three typical streets were chosen in each health area according to the pedestrian traffic: a busy street, a moderately busy street and a quiet street. Once each week, the observers visited the streets for 1 h; scored the use of barrier measures; and interviewed some pedestrians, selected at random. Data were stored in a software application downloaded to the observers' smartphones.

The use of barrier measures was scored based on three indicators: street population density, physical distancing and use of face masks. Only the use of face masks has been considered in this article. Each pedestrian interview was geolocated, dated and saved to the server. Interviews consisted of three parts: awareness of barrier measures, opinion of the usefulness of these measures, and number and health status of permanent residents in the interviewee's household. Only health status has been considered in this article.

The use of face masks on the streets was rated on a four-point Likert scale: all people were wearing face masks, approximately two-thirds of people were wearing face masks, approximately one-third of people were wearing face masks, and very few/no people were wearing face masks at the time of observation. The pilot study showed that mask wearing did not change significantly with time of day.

The health status of permanent residents in the interviewees' households (as reported by interviewees) was estimated from the answers to the following questions: (i) number of permanent residents in their household; (ii) number of sick people in their household on the day of the interview; (iii) probable links between each case of sickness and the COVID-19 pandemic (none, one, two or more); (iv) number of deaths that had occurred in their household within the preceding 30 days; and (v) links between each death and the COVID-19 pandemic (none, one, two or more).

A suspected case of COVID-19 was defined as a patient with fever, respiratory symptoms (e.g. cough, breathing difficulties) and intense fatigue.

Statistical analysis

The usage frequency of face masks and the change over the study period was calculated and represented graphically. To calculate the frequency of mask use, the denominator was the number of street visits during the month and the numerator was the number of streets with all people wearing face masks, approximately two-thirds of people wearing face masks, approximately one-third of people wearing face masks, and very few or no people wearing face masks.

Table 1 shows the population in each health zone and number of people surveyed each month. Table 2 shows the monthly estimates of the prevalence of sickness of any origin in 2020 (i.e. the proportion of permanent residents in the interviewees' households with any undesirable change in health status, as well as estimates of crude death rate). Table 3 shows the results for households with at least one sick person or at least one death (i.e. statistical unit is household, not resident). Table 3 also shows

Table 1
Study population.

Month 2020	Number of health zones included in the survey	Number of health areas included in the survey	Total population of these health areas	Number of people surveyed
May	3	5	165,549	275
June	3	5	165,549	165
July	3	5	165,549	166
August	3	10	319,245	482
September	3	9	261,409	187
October	3	10	319,245	420
November	3	10	319,245	436
December	3	10	319,245	181

Table 2
Sickness and deaths in respondents' homes.

Month 2020	Number of people residing in respondents' homes	Number of sick people in respondents' homes	Number of deaths in preceding 30 days in respondents' homes	Sickness rate per 1000 inhabitants rate (95% CI)	Death rate in preceding 30 days per 1000 inhabitants rate (95% CI)
May	1865	39	9	20.9 (14.9–28.5)	4.8 (2.2–9.2)
June	1147	36	8	31.4 (22.1–43.2)	7 (3–13.7)
July	1127	24	4	21.3 (13.7–31.5)	3.5 (1–9.1)
August	3611	269	30	74.5 (66.1–83.5)	8.3 (5.6–11.9)
September	1305	81	10	62.1 (49.6–76.6)	7.7 (3.7–14.1)
October	2941	188	33	63.9 (55.4–73.4)	11.2 (7.7–15.8)
November	3152	303	55	96.1 (86.1–107)	17.4 (13.1–22.7)
December	1168	142	29	121.6 (103.4–141.7)	24.8 (16.6–35.7)

CI, confidence interval.
Statistical unit: population living in respondents' homes.

Table 3
Sickness and deaths in respondents' homes.

Month 2020	Number of people (i.e. homes) surveyed	Number of respondents reporting sick people in their homes	Number of respondents reporting deaths in preceding 30 days at home	Number of respondents reporting sick people with suspected COVID-19 in their homes	Number of respondents who reported potential COVID-19-related deaths at home in preceding 30 days
		n [rate per 1000 (95% CI)]	*n* [rate per 1000 (95% CI)]	*n* [rate per 1000 (95% CI)]	*n* [rate per 1000 (95% CI)]
May	275	26 [94.5 (62.7–135.5)]	5 [32.7 (15.1–61.2)]	5 [18.2 (5.9–41.9)]	0 [0 (0–13.3)]
June	165	20 [121.2 (75.6–181)]	1 [42.4 (17.2–85.5)]	1 [6.1 (0.2–33.3)]	9 [54.5 (25.2–101)]
July	166	12 [72.3 (37.9–122.9)]	1 [24.1 (6.6–60.5)]	1 [6 (0.2–33.1)]	0 [0 (0–22)]
August	482	154 [319.5 (278.1–363.2)]	52 [56 (37.2–80.5)]	52 [107.9 (81.6–139.1)]	10 [20.7 (10–37.8)]
September	187	51 [272.7 (210.3–342.5)]	12 [48.1 (22.2–89.4)]	12 [64.2 (33.6–109.4)]	2 [10.7 (1.3–38.1)]
October	420	111 [264.3 (222.7–309.2)]	32 [76.2 (52.7–105.9)]	32 [76.2 (52.7–105.9)]	9 [21.4 (9.8–40.3)]
November	436	156 [357.8 (312.8–404.8)]	73 [114.7 (86.3–148.4)]	73 [167.4 (133.6–205.9)]	7 [16.1 (6.5–32.8)]
December	181	74 [408.8 (336.5–484.2)]	34 [149.2 (100.7–209.6)]	34 [187.8 (133.7–252.5)]	9 [49.7 (23–92.3)]

CI, confidence interval.
Statistical unit: home.

the proportion of households with at least one suspected case of COVID-19 or COVID-19-related death within the preceding 30 days (as reported by the interviewees).

From mid-May to mid-December 2020, the following indices were calculated each month from interview data: (i) prevalence of sickness per 1000 inhabitants, calculated as the number of sick individuals in the households divided by the number of permanent residents in the households multiplied by 1000; and (ii) death rate over the preceding 30 days per 1000 inhabitants, calculated as the number of deaths within the preceding 30 days divided by the number of permanent residents in the households multiplied by 1000. Ninety-five percent confidence intervals were also calculated for both indicators.

Comparison of estimated mortality with mortality in previous years required estimation of the annual probability of death. For this, the daily death rate was calculated as the number of deaths in the preceding 30 days divided by 30 and by the number of permanent residents in the households. The annual death rate was then calculated as follows: annual crude probability of death = 1 − exp(−365*daily death rate).

Changes in these indicators over time were quantified and tested using regression models; specifically, a mixed-effect logistic regression model for prevalence of sickness and a mixed-effect Poisson regression model for mortality rate. The use of mixed-effects models enabled repeated measurements in the health areas to be taken into account

All calculations were performed using R software. $P < 0.05$ was taken to indicate statistical significance.

Results

Until August 2020, only five health areas were surveyed (Table 1). Subsequently, the number of surveyed areas was increased to 10, and the number of people interviewed each month ranged between 180 and 480.

In total, the investigators made 662 observations regarding adherence to barrier measures over the 8-month survey period, and found that the frequency of mask use was very low. As shown in Figure 1, few or no people were wearing face masks on at least half of the streets visited each month. However, in June and August 2020, 40% of street visits found that masks were worn by nearly one-third of pedestrians.

At the beginning of the study period (May 2020), the overall or crude monthly death rate per 1000 population was approximately 5, and this increased to approximately 25 in December 2020 (Table 2). This corresponds to daily crude death rates of 1.6 and 8.3 per 10,000 population, and to annual crude death rates of 60 and 260 per 1000 population, respectively.

The mixed-effect logistic regression model confirmed the increase in the proportion of sick people in the interviewees' households ($P < 0.05$), and Poisson regression analysis confirmed the increase in the incidence of mortality in the interviewees' households ($P < 0.05$).

From mid-May to mid-December 2020, the number of suspected cases of COVID-19 increased six-fold (Table 3). Nearly one in four deaths that occurred in the 30 days preceding the interviews (46 of 210 over the whole study period and nine of 34 in December 2020) were considered to be related to COVID-19.

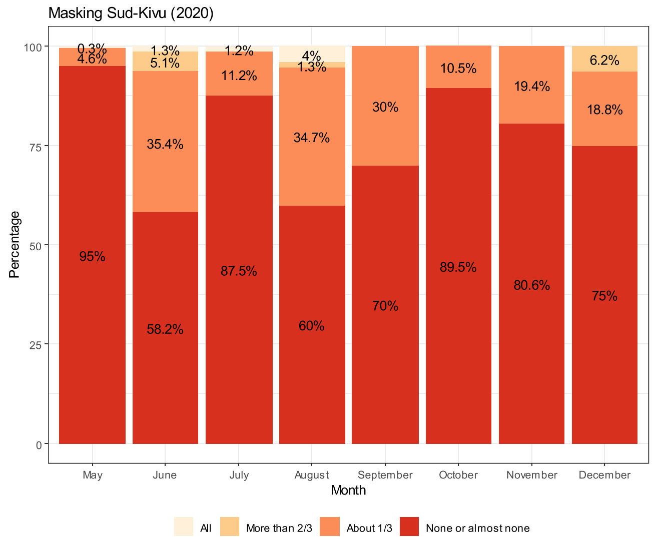

Figure 1. Use of face masks observed on the streets.

Increases in morbidity and mortality in November and December 2020 were apparent. The mixed-effects logistic regression model confirmed the increase in prevalence of at least one sick person in the households ($P < 0.05$), as well as the increase in the proportion of households where deaths had occurred over the preceding 30 days ($P < 0.05$). Similar results were found when the regression models were applied to suspected cases of COVID-19.

Discussion

The pilot survey methodology proved to be reproducible over several months with no reduction in data quality (Wimba et al., 2020). With very limited resources, the pilot study allowed the collection of data on adherence to barrier measures and on health status in the interviewees' households. The results are of concern. Face masks were worn by less than one-third of the population, a large number of people appeared to be in poor health, and death rates were very high. The situation deteriorated dramatically over the course of 2020, exceeding the international reference for a 'humanitarian crisis'. According to the interviewees, COVID-19 was considered to be responsible, in part, for the increased morbidity and mortality (approximately one-fifth of reported events).

A study conducted in another region of South Kivu (Jarrett et al., 2020) investigated the feasibility of, and interest in, prospective collection of information on sickness in regions with health instability. The results obtained from prospective surveys have shown comparable reliability to results obtained in retrospective household surveys, but prospective surveys are able to provide information on changes in epidemiological indicators.

As mentioned previously, the resources required to perform this survey were limited (Wimba et al., 2020), and needed to cover investigator training costs, supervision costs, and the costs of internet connections on mobile phones used in the field. At the end of the 8-month study period (May–December 2020), the data collected from pedestrians was compared with data collected from a subsample of households to check the reliability of the interviewees' answers. Anxiety generated by the pandemic may have increased the number of suspected COVID-19 cases reported by the interviewees. The number of deaths over the preceding 30 days may also have been overestimated. Generally, framing a study period by particular dates of the year (religious or national holidays, various cultural events, etc.) improves event recall. This was used in a study in Fizi health zone (Jarrett et al., 2020), and should be considered in future surveys.

The overall crude death rate in the DRC is among the highest in the world and the majority of deaths are caused by preventable infectious diseases. The United Nations has estimated the annual crude death rate at 15.5 per 1,000 people in 2013 (United Nations Department of Economic and Social Affairs, 2013) and at 10 in 2015 (United Nations World population prospect, 2019). Recently, these death probabilities have greatly increased due to the direct and indirect effects of armed conflicts (CDC, 2003). In South Kivu, mortality has reached two- and fourfold the UN estimates (Roberts and Zantop, 2003) ; i.e., 20 to 40 per 1,000 people.

The overall or crude death rate measured in this survey in May 2020, during the first wave, was approximately 60 per 1000 population, which is approximately 30% higher than the upper bound of predictions reported in previous publications. The increase from May to December 2020 to 260 deaths per 1000 population is even more alarming despite possible estimation bias.

In the absence of biological diagnosis of COVID-19 in the present study, there are reservations regarding the contribution of the COVID-19 pandemic to the current health crisis. Indeed, the fact that four of five reported events could not be attributed to COVID-19 supports the contribution of other influential causes. Within a context of a tense and insecure environment due to armed conflict, the pandemic may have aggravated difficulties with everyday living, and exposed many families to the disastrous consequences of both armed conflict and the COVID-19 pandemic.

Fears about the multiple consequences of the spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in Africa were expressed as early as May 2020 (Etard et al., 2020; Wells et al., 2020). Several potentially mitigating factors have been suggested: (i) the youth of the population that is likely to reduce COVID-19-related morbidity and mortality (Lalaoui et al., 2020; Nguimkeu and Tadadjeu, 2021; Villalonga-Morales, 2020); (ii) recent experience of DRC in the management of other severe epidemics (e.g. Ebola) that would trigger rapid responses [actually implemented in April 2020 in South Kivu (i.e. less than 1 month after the first case of COVID-19 was reported in DRC] (Afolabi et al., 2020; Anoko et al., 2020; Mobula et al., 2020); (iii) previous hypothetical infections with viruses similar to SARS-CoV-2 that are likely to elicit cross-reactive immune responses able to slow down viral spread and decrease the severity of infection (Lv et al., 2020; Mateus et al., 2020); and (iv) the presence of genetic factors and common outdoor living in Africa that may decrease the prevalence of COVID-19 (Lalaoui et al., 2020). Other studies have suggested (but without sufficient evidence) the benefits of various anti-infective agents (e.g. chloroquine, hydroxychloroquine, azithromycin) in the management of COVID-19 (Ibáñez et al., 2020; Kashour et al., 2021; Meo et al., 2020).

Nevertheless, other factors have led to fear of a humanitarian catastrophe due to the direct and indirect effects of the COVID-19 pandemic, including: (i) the health system has limited resources and a large part of the population has limited access to care (Juma et al., 2020); and (ii) the nutritional status of the population is poor because of scarce resources and recurrent political and security instabilities.

In South Kivu, several epidemics have weakened the health status of families (e.g. cholera, measles and various respiratory infections) (Bompangue et al., 2009; Munyuli et al., 2013). Strict adherence to barrier measures or lockdown is not compatible with the reliance of a large part of the population on daily employment income (Ahmed et al., 2020; Mathew et al., 2020; Wallace et al., 2020). The present study confirmed the low level of adherence to barrier measures. Anxiety generated by the health crisis has deterred the population from attending health facilities. As such, patients no longer receive adequate care for health conditions unrelated to COVID-19 and primary care (e.g. pregnancy), and there is already evidence of the negative impact of the pandemic on regular vaccination programmes, access to human immunodeficiency virus antiretroviral treatment, and malaria prevention (Anonymous, 2020; Hogan et al., 2020; Nachega et al., 2020).

In conclusion, continuous weekly street surveys and pedestrian interviews by adequately trained interviewers provided valuable information on the health status of this population. In South Kivu, the health status of the population has been affected deeply since the onset of the COVID-19 pandemic and is deteriorating rapidly. Nevertheless, only a limited part of this deterioration seems to be linked to COVID-19. Barrier measures and lockdown alone do not seem to be sufficient to contain the pandemic and improve the health status of the population in this deprived region of the world.

This study was conceived as an extension and to support a previous survey to provide information on current health conditions in South Kivu from the population's point of view. It found that the increases in morbidity and mortality were likely to be linked to the outbreak of COVID-19 in the area, but did not provide a causal or strong association between the epidemiological indicators and the disease. Indeed, at the time of the study and within its timeframe, it was not possible to collect data on laboratory tests, hospital admissions and causes, hospital deaths and causes, and funerals. In a highly deprived context, access to laboratory analyses, hospital care and funerals may be seriously hampered by poverty and stigma. In addition, other types of data were not collected to avoid adding bulk to the interview grid (e.g. age, sex, histories of people who died, other declared plausible causes of death).

The use of population-reported data is obviously subject to various causes of bias, such as over-reporting as a call for help or under-reporting as protection against stigma. Nevertheless, in some difficult conditions, these data are all that are available to inform rapid implementation of corrective measures.

The limitations of this study call for some degree of caution in interpretation of the findings, and should be addressed in any future work on the subject. Further studies should combine hospital-based and community-reported data, and seek the contribution of public health specialists in the region.

Ethical approval

The provincial health authority of Bukavu approved this study on 9 May 2020.

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Conflict of interest

None declared.

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