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Contribution to the Study of Risk Factors for Cholera in City of Uvira in South Kivu Province of Democratic Republic of the Congo (D.R.C.)

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Abstract

The objective of this work was to identify the risk factors for cholera and to propose an appropriate control strategy. It is therefore, a case control analytical study conducted in Uvira for the period from January to December 2020. The strength of the association between exposure and disease is estimated by the odds ratio. It has been observed that no age has been spared from cholera, with an overrepresentation of men. The disease has a strong predilection for regions with problems with hygiene, water and sanitation. Our study identified risk factors, such as contact with cholera; a lack of waste disposal system; a lack of running water and soap to wash hands before meals and after passing stools; a lack of hygienic latrines; a lack of water treatment for drinking; the consumption of food left uncovered by vendors at the roadside; the consumption of the raw fruits, tubers and foods; the conservation of drinking water in a container with a non-narrow collar; illiteracy; and the consumption of well water. However, all of these factors are vulnerable through a multisectoral approach through control strategies, such as governmental political commitment, behavior change, communication, epidemiological surveillance, community participation and funding of drinking water programs to improve accessibility and environmental sanitation.

Keywords

Risk Factors, Cholera, City of Uvira

1. Problematic

Known since Greek antiquity, cholera spread throughout the world in the twentieth century, achieving seven pandemics. The last pandemic, in 1961, was accom-

panied by a major bacteriological change in the infectious agent, which was no longer the classical *Vibrio cholerae* but the *Vibrio el tor*. In 1992, a major outbreak occurred in southern India, due to a new strain of *Vibrio cholerae* non-O1*cholera* is a diarrheal disease caused by infection of the gut by the bacterium *Vibrio cholerae* that can affect both children and adults [1] [2]. About 20% of those infected have acute watery diarrhea.

In 10% or 20% of them, severe water diarrhea is accompanied by vomiting. In the absence of appropriate prompt treatment, significant loss of fluid and salt can lead to severe dehydration and death within a few hours. The lethality rate can reach 30% - 50% in untreated subjects. The treatment should keep lethality below 1% [3].

Cholera is a diarrheal disease caused by infection of the intestine by the bacteria *Vibrio cholerae*, *type 01 or 0139*, which can affect both children and adults. About 20% of those infected have acute watery diarrhea. In 10% - 20% of them, severe watery diarrhea is accompanied by vomiting. In the absence of appropriate rapid treatment, the loss of such large amounts of liquid and salt can lead to severe dehydration and death within a few hours [4].

The lethality rate in untreated cases can reach 30% - 50%. Treatment is simple and based on extensive rehydration; when properly applied, it should keep the fatality rate below 1% [4]. Water and food contaminated with fecal matter are generally responsible for the transmission of cholera, a risk that remains constant in many countries. New outbreaks can occur sporadically in any part of the world where water, sanitation, food safety and hygiene are lacking [1] [3] [4].

The most risks are those living in crowded areas or refugee camps, where sanitation and drinking water quality are inadequate and the risk of interpersonal transmission is increased. Given the short incubation period (2 hours to 5 days), the number of cases can grow extremely rapidly. Researchers have estimated that each year there is 1.3 to 4.0 million cases of cholera, and 21,000 to 143,000 deaths worldwide due to cholera [5].

The spread had been facilitated by caravans and the slave trade [2] [6]. The twentieth century saw the seventh pandemic due to the el tor biotype [2] [7]. With the participation in the pilgrimages of Mecca, cholera was introduced and disseminated in Africa in the seventies. The Congo was affected by the first epidemic in 1973, limited to the Mayumbe region [8]. It was from 1978 that the epidemic spread in the Great Lakes region and along the Congo River. Since 1981, epidemics have occurred regularly in the province of Katanga, in the southeast of the Democratic Republic of Congo (DRC).

A particularly serious outbreak occurred in 1994 in Goma, the displacement of populations. The first documented outbreak in the province of Katanga dates from 1997, with 1084 cases and 75 reported deaths (lethality: 7%) in health areas located on the east shore of lake Moero (Kasenga, Kilwa, Mpweto), on the east shore of Lake Tanganyika (Moba), in the north of the province (Kongolo) and in Lubumbashi. Since then, cholera has been endemic in the lake regions and the town of Lubumbashi [9].

Given the public health risk posed by cholera, it can cause many deaths, spread rapidly, including internationally, and seriously affect travel and trade [10]. It is of the utmost importance, in the event of an outbreak, that the response be well coordinated and implemented in a timely and effective manner. The implementation of the response must always be followed by the planning and implementation of preparedness measures to manage future outbreaks more effectively [4].

Cholera thus remains a current problem in the world. In 1998, more than 240,000 cholera cases resulting in 8443 deaths were reported to WHO by 59 countries. The countries most affected are those with inadequate health structures, low socioeconomic levels and where there are concentrations of populations (displacement during wars and famines). The continent was most affected in 1998, with 9/10 of the world's reported cases and cholera deaths, more than half of which were in the Great Lakes region (Uganda, DRC, Kenya, Tanzania, Mozambique) [1].

To contract cholera, you usually need to ingest a large amount of the microorganisms. Of those infected about 80% remain asymptomatic and less than 5% have a serious condition characterized by bulky but painless watery stools [3]. In third World cities, and more particularly in disadvantaged neighborhoods, drinking water and sanitation needs are partially covered, taking into account current needs and the rapid population growth [3] [4].

The practice of open defecation, the uncontrolled discharge of sewage and garbage and the inefficiency of surface water drainage (resulting from flooding, the accumulation of sewage or poor storm runoff), seem inconsequential in sparsely inhabited rural areas, resulting in the pollution of fresh water resources and the resurgence of water diseases [11].

Cholera is a complex disease. Understanding its etiology requires a multifactorial analysis of its determinants. This etiology is characterized by its multisectorality. The sociodemographic and microsocial, political and economic, ecological and climatic nature of the factors determining the appearance and outbreak of cholera must be considered within a multidisciplinary analysis in order to allow a qualitative assessment of the risk of an epidemic [3].

Thus, measures implemented in the event of cholera outbreak generally focus on the medical aspects that are important for reducing mortality. However, more comprehensive measures are needed to limit the spread of the disease. As operations are often led by doctors, other aspects, such as environmental or communications, may be neglected [4].

Also, by week 48 of 2020, the West region recorded 22,366 cases and 475 deaths of cholera (case-fatality rate 2.1%). The Congo River Basin remains the main outbreak in 2020 with 18,616 notified cases or 83% of the cases notified in the region. The Gulf of Guinea and Mano River basins are experiencing an increase in cases from 122 cases in 2018 to 322 cases in 2020. The Congo River Basin, the main focus in 2020, shows a significant decrease in cases in 2020 compared to 2019 and 2018. The Lake Chad Basin has seen a drastic decrease in cas-

es since 2019, but this decrease remains stagnant between 2019 and 2020 [12] (Figure 1).

Taking into account the specific transmission profile of cholera, asymptomatic but contagious carries. It is necessary to fear contamination by sick people but also by healthy carriers [13].

We would like to emphasize that each epidemic is unique and that no measure can be presented as a universal panacea [13]. To this end, we intend to determine why the epidemic is occurring in the city of Uvira. And Uvira is located at the extreme north end of Lake Tanganyika. Kalundu is a lake port at the southern end of the town, which provides links by boat to Kalemie in Katanga Province, Kigoma in Tanzania, Pulungu in Zambia and Bujumbura (the largest city and former capital of Burundi) (Figure 2: Map of Uvira).

2. Subject Interest

For some time now, we have seen a cholera outbreak in the city of Uvira. Determinants analysis can predict the emergence of infectious outbreaks or the re-emergence of an epidemic. To achieve this, we proposed conducting a study of the risk factors for a cholera epidemic. This does not mean that the factors thus identified are exclusively direct causes of the cholera explosion, but in practice, their identification may be sufficient to allow the implementation of concrete measures for the surveillance and prevention of the disease.

3. Objectives

The Overall objective of this work is to contribute to the improvement of the health status of the population through the reduction of cholera morbidity and mortality. The specific objectives of our study are: Identify cholera risk factors and propose an appropriate strategy for the fight.

Cholera Platform — Western and Central Africa

Cholera Outbreaks in Central and West Africa : 2020 Regional Update - Week 1– 48

Country Name	2020									Total suspected W1-W48, 2020			2019 (W1-W48)		
	W1-40	W41	W42	W43	W44	W45	W46	W47	W48	Cases	Deaths	CFR	Cases	Deaths	CFR
Benin	203	6	3	8	2	0	2	0	0	224	5	2,2%	45	0	0,0%
Burkina Faso	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Cameroon*	1861	4	4	9	0	1	0	4	2	1 885	80	4,2%	788	38	4,8%
Central African Republic	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Chad	0	0	0	0	0	0	0	0	0	-	0		98	4	4,1%
Congo	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Congo (RD)	16156	409	392	274	231	245	217	266	426	18 616	304	1,6%	27 875	483	1,7%
Cote d'Ivoire*	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	0	-	2	0	0,0%
Ghana	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Guinea*	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Guinea Bissau	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	0	-	-	0	-
Liberia *	76	1	2	6	7	3	1	0	0	96	2	2,1%	116	1	0,9%
Mali	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Niger	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Nigeria	1127	176	106	48	53	0	14	19	0	1 543	84	5,4%	2 548	13	0,5%
Sénégal	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Sierra Leone	0	0	0	0	0	0	0	0	0	-	0	-	-	0	-
Togo	2	0	0	0	0	0	0	0	0	2	0	0,0%	-	0	-
Lake Chad River Basin	2 988	180	110	57	53	1	14	23	2	3 428	164	4,8%	3 434	55	1,6%
Congo River Basin	16 156	409	392	274	231	245	217	266	426	18 616	304	1,6%	27 875	483	1,7%
Guinea Gulf and Mano River Basin	281	7	5	14	9	3	3	-	-	322	7	0,0%	163	1	0,6%
WCAR 2020	19 425	596	507	345	293	249	234	289	428	22 366	475	2,1%	31 472	539	1,7%

Figure 1. Cholera outbreaks in central and West Africa [12].

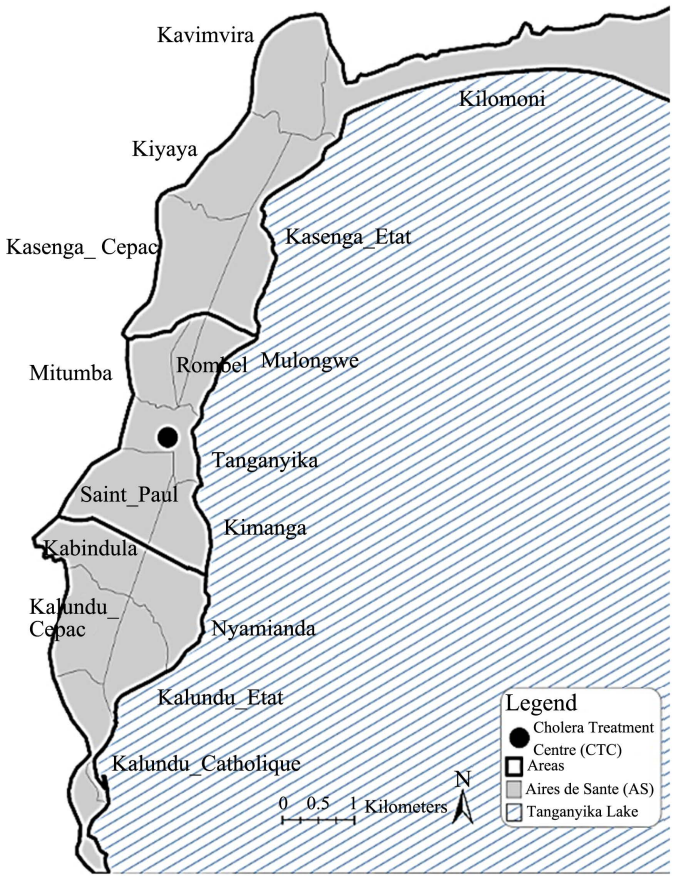

Figure 2. Map of Uvira [12].

4. Methodology

To assess the weight of each risk factor on the occurrence of cholera in the study environment, a case control analytical study was selected as the study type [14]. Based on the literature review, risk factors [3] [15] [16], economic [9] [14] [17] [18] [19], demographic and sociological [9] [14] [20] [21], geographic and ecological [3] [9] [11], Health [20], and anthropogenic [20] determinants were selected in our study [9] [14] [17] [18] [19] [22] and historical determinants.

4.1. Nature of Study

A descriptive, retrospective study was conducted to describe the outbreak and to identify environmental health factors that contributed to the outbreak. The preliminary assessment was done by means of Microsoft Excel 2003 and thereafter followed by statistical analysis of the database using Epi Info statistical software.

4.2. Duration and Sample of Study

Our study covers the period from January to December 2020. During this period, we examined 80 cholera cases recruited in the city of Uvira. We applied a stratified sampling proportional to the first degree and then a systematic sampling to the second degree. The sample size was calculated using the stat func-

tion calculation of Epi Info software version 3.3.2, taking into account the following parameters [23]: materiality threshold: 5%; the proportion of non-sick for factor studied: 50%; the proportion of patients for a factor studied: 60%; power: 80%, beta: 20%; confidence interval: 95%; one case for a witness.

5. Results

Our work is aimed at studying the risk factors underlying the cholera outbreak in the city of Uvira (Uvira is a city in the South Kivu Province of the Democratic Republic of Congo, area of Uvira: 74 km^2, a population urban is 59,000) and proposes an appropriate control strategy to help improve the health of our population.

5.1. Description of the Epidemic in the City of Uvira

During the period of our study, the patient registry of the Center for surveillance and follow-up of Hospitalized patients at the General Hospital in Uvira recorded a total of cholera 80 cases, 5 of 80 which were fatal, that is 6.25%.

The average age is 22 years, the median age is 19 years, the median age is 19 years, the first quartile 25% is 7.5 years, the third quartile 75% is 32 years, the modal age is 10 years and the maximum age is 72 years. Our study included 80 patients included 52 men and 38 women (**Figure 3**). The majorities of our patients (70%) are in rural areas and live mainly on livestock and agriculture.

5.2. Distribution of the Association between Water Supply Source and Status

Of 25 subjects with a well as a water supply, 17.5% were affected by cholera and 11 (13.75%) did not contract the disease. Similarly, among 56 subjects served by the public network through taps, 33.75% contracted cholera and 36.25% remained unaffected. Using tap water also predisposes individuals to the risk of the condition as much as those using well water because there is not a large difference between cases and controls for both water supplies.

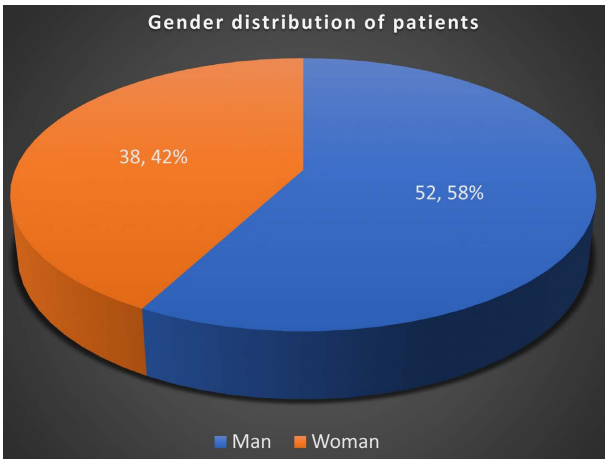

Figure 3. Gender distribution of patients in center of surveillance in hospital of Uvira.

5.3. Distribution of the Association between the Consumption of Food (Wells, Tubers...) Exposed by Roadside Sellers

Considering the consumption of foods sold by the roadside, there are 37.5% that use it and 12.5% that do not. And there 5 controls that consume it versus 15 that do not consume it out of 60 controls. Those who consume roadside foods are more likely to contract cholera than those who do not. Of 60 subjects (75%) exposed to the consumption of roadside food, 44 (73%) contracted cholera and 16 (27%) did not. Which is an odds ratio (OR) of 7.87 with a 95% CI = [5.69 - 10.89] with a p-value < 0.05.

5.4. Distribution of Association between Latrine State and Status

Out of a total of 60 cases of cholera, 56 cases have unclean latrines and 4 have clean latrines. Out of a total of 20 controls, 17 had unclean latrines compared to 3 with clean latrines. Using unclean latrines is more likely to cause cholera than using hygienic latrines. Of the 73 subjects exposed to the use of a dirty latrine, 63% were affected by cholera and 37% were not. Of the 7 subjects exposed to the use of hygienic latrines 86% were unaffected, compared with only 14% who were affected by cholera. Which is an odds ratio (OR) of 11.65 with a 95% CI = [7.73 - 17.63] with a p-value < 0.05.

5.5. Distribution of Association between Untreated Drinking Water (Through Filtration, Chlorination and/or Boiling) and Status

Of 60 cases, 97% consumed raw water and 3% consumed treated water. Of 20 controls, 78% consumed raw water and 22% consumed treated water. Consumption of untreated drinking water may increase the risk of developing cholera more than treated drinking water. The odds ratio (OR) is 8.6 with a 95% CI = [4.58 - 16.4] with a p-value < 0.05.

5.6. Distribution of Association between Contact with Cholera and Status

Of 60 cases of cholera, 92% were in contact with cholera afflicted subjects and 8 % were not. Of 20 controls, 2% were in contact with cholera and 98% were not. Contact with a cholera patient predisposes individuals to the risk of contracting cholera more than those who have no contact with cholera. The odds ratio (OR) of 93.43 with a 95% CI = [53.77 - 164.07] with a p-value < 0.05.

5.7. Distribution of the Association between the Lack of a Waste Disposal System (Household Waste)

Of 60 cases of cholera, 80% were in contact with cholera afflicted subjects and 20 % were not. Of 20 controls, 17% were in contact with cholera and 83% were not. It is found that subjects with a waste disposal system are not as likely to contract cholera as subjects without it. The odds ratio (OR) of 22.84 with a 95% CI = [15.63 - 33.43] with a p-value < 0.05.

5.8. Distribution of the Association between Education and Status

We note that out of the 60 cholera cases, 25% have no level of study and 31 is 45% have a primary or higher level of study. In 20 controls, 5 had no level of study (25%) compared to 70% with a primary level of study or higher (5%). The OR is 2.29, a 95% CI of [1.54 - 3.39] with a p-value < 0.05.

6. Discussion

6.1. Description of the Epidemic in the City of Uvira

A recent multi-country study on the etiology of moderate to severe diarrhea in children under five years showed the proportion of diarrheal disease attributable to *V. cholerae* increased as age increased [24] [25]. Another study on the change in enteric pathogen prevalence during floods showed the prevalence of toxigenic *V. cholerae* was higher in adults than children [26]. In our own study, we found a higher proportion of *V. cholerae* pathogens in adults than in children, and children carried more pathogens than adults.

However, in a study on the factors of the spread of the cholera epidemic in Mali in 2003, the epidemic affected all ages from 1 year, with a predominance of the age group of 20 years, which seems to be the most mobile in these regions. The median age is 24 years [27]. Similarly, our study showed that the minimum age is 1 year and that the age most affected is 10 years with the median age being 19 years [28]. In 2004, a study in Dakar showed that the average age was 30 years [29]. It follows from these findings that the "*age of the subjects likely to be affected by cholera*" varies from country to country.

Referring to the sex distribution, previous studies from Madagascar and Dakar gave the sex ratios of 1 and 1.33, respectively. Our study found a sex ratio of 1.43. This reflects that men are 1.43 times more likely to contract cholera than women [28] [30]. Dao *et al.* found that the sex ratio is 1.03 in favor of men in a study carried out in Mali in 2005 [26]. In all cases, we found that there is an overrepresentation of men except in Madagascar, which may also be the subject of further study.

Regarding the origin of the patients' subjects, Diop and his collaborators described, in a study carried out in 1991 on cholera in Dakar, that this disease of fecal peril has always developed in densely populated neighborhoods with important problems of hygiene, water and sanitation, maintaining commercial relations with "source" spaces [31]. This was also described in Bangladesh and Douala [21]. In view of the pattern of the frequency of cases observed in health areas of Katuba, in Kampala and Kenya, the number of cholera cases is proportional to population size.

6.2. Distribution of the Association between Water Supply Source and Status

In the context of climate change, rainfall patterns are dynamic. Heavier and frequent precipitation in some areas can overwhelm wastewater treatment plants

and septic systems, resulting in contamination of surface water and wells. On the other hand, lower rainfall in other regions may cause droughts and water scarcity, leading to increased microbial load in limited water supplies, use of contaminated rainwater, or competition for scarce water [30]. Altered rainfall patterns, higher temperatures, and intense and more frequent weather extremes, often resulting in natural disasters in countries with vulnerable infrastructure, are likely to compromise the supply of clean and safe water, sanitation, and the function of drainage systems with important consequences to the spread of water-borne diseases including cholera [32]. The schematic representation of the major drivers for cholera infection or cholera outbreaks is presented in **Figure 4**.

6.3. Distribution of the Association between the Consumption of Food (Wells, Tubers...) Exposed by Roadside Sellers

Other research in Nyanza province in Kenya has also shown that high rates of rural cholera have been attributed to using contaminated water from rivers, eating contaminated food and sharing meals at funerals and communal parties [34]. While these findings and ours indicate the need for better infrastructure and general development, specific interventions are also relevant for use in endemic areas, such as vaccines as an interim measure while development proceeds. It lacks an adequate water supply, sewage system and health services. From our field observations, poor sanitation and food hygiene are notable at roadside kiosks [34].

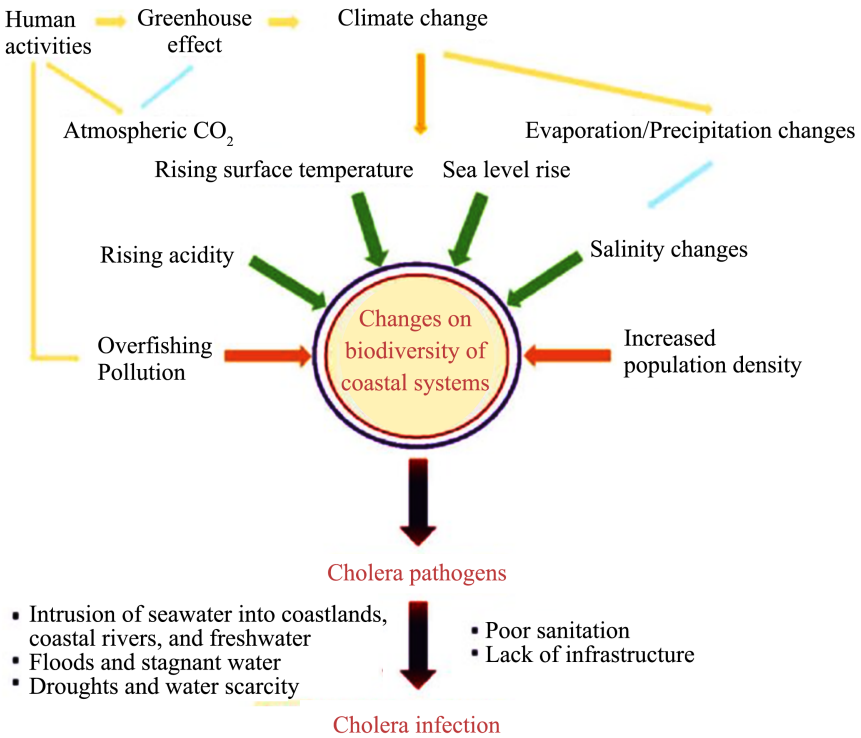

Figure 4. Climate change on oceans and *Vibrio cholerae*: Schematic representation of the major drivers for cholera infection or cholera outbreaks [33].

Also, in Mbuji-Mayi in the Democratic Republic of Congo, eating peanuts and doughnuts sold on the road places the consumer at 3.26 times more risk of cholera (OR = 3.26) which means handling food by sellers or buyers can also be a source of contamination [8].

6.4. Distribution of Association between Latrine State and Status

According to the research of Nyambedha *et al.*: "*Perceived causes of cholera at both the sites were similar, including* '*drinking contaminated water*', '*dirty environment*' *and* '*lack of latrines. Environmental issues, particularly* '*dirty environment*' *and* '*flies*', *were more prominent among urban respondents, although the last was reported by about 96% at each site* [34]".

In Kenya, rural residents explained how stool is passed in the open bush because pit latrines are unavailable in homes, and stool is washed into the river when it rains. Using such water from rivers and streams contaminated with human faeces was acknowledged as a cause of cholera. 'Eating unprotected/spoiled food' was the second most prominent perceived cause at the rural site. Narratives in the rural setting referred to poor food hygiene when food is served at funerals and other social gatherings [34].

In Mali, fecal matter is sometimes disposed of in septic tanks that are not well protected or discharged directly into rivers or washed away by runoff [27]. This is also deplored in Comoros [14]. In Madagascar, moreover, the comfort zones are often close to the water points; thus the risk of contamination of the water table is equally possible [20].

6.5. Distribution of Association between Untreated Drinking Water (Through Filtration, Chlorination and/or Boiling) and Status

Lack of treatment of drinking water was identified as a risk factor in our study. Using untreated drinking water increases the risk of cholera in Bukavu by 8.6 times (OR = 8.6). In Pohnpei, the presence of chlorine solution has been shown to be protective (OR < 1) [35]. Boiling water is also a method for removing harmful microbes [35].

Many types of research demonstrate the effectiveness of chlorine tablets in inactivating *V. cholerae* in drinking water. Furthermore, we observed a significant reduction in symptomatic cholera infections and a 47% reduction in overall cholera infections [36]. Although it is not possible to quantify the health impact of the chlorine tablets alone because this intervention included handwashing with soap, this finding in combination with no *V. cholerae* being found in stored water in the intervention arms suggests that chlorine can provide a promising approach for cholera control for high-risk cholera patient households in Dhaka city, Bangladesh [37].

6.6. Distribution of Association between Contact with Cholera and Status

In Mbuji Mayi, the OR for this factor is 5370. Also, Shapiro *et al.* found in Kenya

an association between receiving food from someone with watery diarrhea and cholera [22]. There are also other contexts in which one can come into contact with cholera, especially during funeral rites, visits and care [6] [20] [27].

6.7. Distribution of the Association between the Lack of a Waste Disposal System (Household Waste)

The lack of a waste disposal system (household waste) places individuals 22.84 times more at risk of contracting cholera (OR = 22.84). This is often the origin of precarious hygiene conditions, as identified in Madagascar and [20] [21]. Ipso facto, flies find a favorable environment for their development as well as all the consequences that follow from it in a precarious environment. In the Mbuji Mayi study, the presence of flies around meals increased the risk of cholera by 2.88-fold (OR = 2.88) [8]. The low level of the study showed that it was 2.29 times more likely to develop cholera (OR = 2.29). Other studies had already identified it as a risk factor, notably that of Renaud Piarroux in Comoros in 1998 and that of Ali *et al.* in Bangladesh in 2002 [14] [18].

Moreover, Quick *et al.* showed that the knowledge of the population on the means of preventing cholera is a protective factor (OR = 0.2; 95% CI = 0.1 - 0.8) [38].

6.8. Distribution of the Association between Education and Status

According to the research of Mpazi *et al.*: "*Geographical, socio-economic and socio-cultural backgrounds of people in the affected area which influence practices may also contribute to spreading of cholera. These include low educational level, unhygienic food handling practices and proximity to surface water*" [39]. Furthermore, with increased urbanization, cholera will be an increasing problem in the future where sanitation and water safety are not adequate. Knowledge attitudes and practice about the awareness of the people about cholera outbreaks are important for planning preventive health education programmes. Cholera control is far cheaper and more effective by means of a preventive strategy than a curative one. This study intended to assess the knowledge, attitudes and practice that influence cholera outbreaks in Dar-es-salaam city [14] [18] [38] [39]. Other studies had already identified it as a risk factor, notably that of Renaud Piarroux in the Comros in 1998 and that of Ali *et al.* in Bangladesh in 2002 [14] [18].

7. Conclusion

Cholera remains a major public health problem in developing countries in general and in the city of Uvira in particular. Factors contributing to the spread of cholera include contact with a cholera patient, lack of a waste disposal system, lack of running water and soap to wash hands before meals and after passing stools, lack of hygienic latrines, lack of treatment of drinking water, consumption of food exposed by vendors at the roadside, consumption of fruits, tubers and raw foods; keeping drinking water in a container with a non-narrow collar, illiteracy, and well water consumption. The study suggests specific socio-cultural, so-

cio-economic and environmental practices, which should receive priority attention. These include sources and quality of water, types of toilet facilities, access to a general sewerage system, management of solid and liquid wastes and other hygienic habits. Findings of this study show that environmental and socio-cultural practices may strongly influence the recurrence of cholera outbreaks.

8. Recommendations

Based on our study, our recommendation asks the population to change their behavior and no longer practice risk behaviors regarding cholera. Control of cholera can only be effective if people will change their behavior and no longer practice risk behaviors regarding cholera. The following are recommendations that may be made based on the findings of this study:

- To population: Shallow well water should be treated regularly; making available a trash can or a garbage hole for disposal of waste (household waste); the mandatory use of hand washers and building a hygienic latrine and a well-protected septic tank; ensure that drinking water is boiled, chlorinated or filtered; avoid eating raw food; and keep drinking water in a narrow-necked container.
- To health authorities: Countries with ongoing cholera transmission should consider its use in their public health programs, identifying areas and target populations who will benefit from the use of the vaccines. Strategies that will facilitate accessibility and usage of these vaccines will need to be developed.
- To the political and administrative authorities: respect, protect and fulfill the human right to safe drinking water and sanitation as a fundamental human right.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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