

ORIGINAL ARTICLE

Factors influencing the high prevalence of Cholera cases in Masala Area, Ndola District, Zambia: A Case study of Masala

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ABSTRACT

Background: Cholera, a severe diarrhoeal disease caused by Vibrio cholerae, is primarily transmitted through contaminated food and water, often due to poor sanitation and inadequate access to clean water. Globally, cholera affects 1.3 to 4 million people annually, leading to 21,000 to 143,000 deaths. In Zambia, cholera was first recorded in 1977, with 29 outbreaks reported to date. The latest outbreak, beginning in October 2023, has resulted in over 20,500 cases and 699 deaths, with Lusaka as the epicentre. Ndola recorded more than 600 cases in a week, which over 50% of those cases came from Masala. This study aimed to investigate factors influencing the high prevalence of cholera in Masala area.

Methods: A mixed methods cross sectional study was used, which applied simple random sampling of individuals and health care providers respectively. The sample size was determined using Fischer's formula to obtain a sample of 365 participants and 13 informants. Statistical analysis including

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Jonathan Ntambo, Department of Public Health, Chreso University, PB 40987 Ndola, Zambia. Email: jonathanntambo2@gmail.com demographics, logistic regressions, and descriptive analysis was performed using SPSS analysis tool.

Results: Findings indicated that most respondents were aged 20-39 years (60.3%), with more female participants 228(62.6%) than males 137(37.4%). Key protective factors included proper toilet use (Ω R=1.38; 95% CI 0.80–2.37) and washing hands after using the toilet (Ω R=3.54; 95% CI 1.42–8.81; p=0.01). Significant risk factors included not washing hands after handling children's faeces (Ω R=1.98; 95% CI 1.13–3.46; p=0.02), consuming unwashed fruits or vegetables (Ω R=0.41; 95% CI 0.25–0.69), and improper food cooking practices (Ω R=0.52; 95% CI 0.28–0.96; p=0.04).

Conclusion: Cholera occurrence is predicted by knowing prevention measures such as proper toilet use and washing hands after use of toilet. Hygiene factors including not washing hands regularly and proper food handling. Strengthening community health education on sanitation, ensuring safe drinking water, promoting toilet ownership, and increasing cholera vaccination awareness are critical to reducing cholera cases in Masala.

Keywords: Cholera, prevalence, prevention, Masala, Ndola, Zambia, strengthening, determinants, disease outbreaks, risk factors

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INTRODUCTION

Globally, it is estimated that each year there are 1.3 million to 4 million of cholera cases recorded. Case mortality rate from cholera ranges from 21 000 to 143 000. Cholera is of great public health concern especially in Africa. Cholera is a severe diarrhoeal disease, that is caused by a gram-positive bacterium known as Vibrio cholerae. According to the WHO, there were over 200,000 cholera cases in 2023 of which 1903 with a Case Fatality Rate (CFR) of 1.4% within the African Sub-region. Despite high mortality cholera can be treated and prevented easily. Prompt administration of Oral Re-hydration Salt (ORS) has been proven to be effective in the treatment. Patients who are severely dehydrated are at high risk of going into shock and will require prompt intravenous fluids administration. Appropriate antibiotics may be needed to help in the control of the diarrhoea and to clear the bacterium.²

The recent cholera outbreaks in Zambia began in October 2023 following the detection of clusters of cases from Lusaka (Matero and Kanyama suburbs, currently known as the epicentre). Since then, the outbreak had spread to nine of the ten Provinces of Zambia, with a marked increase in transmission observed between mid-December 2023 and January 2024. As of 19th January 2024, a total of 11,304 cases and 448 (CFR-3.9%) deaths have been reported from 47 districts in nine Provinces, and of the total deaths reported, 199 were health facility deaths, while 249 were community deaths.³ Currently, 821 patients are on admission in various cholera treatment centres across the affected provinces, with 660 (80%) of the total admission cases being in Lusaka. Lusaka has held the highest case count of about 60% of the cases recorded, and Ndola coming in second. Masala area of Ndola district to be specific has been an epicentre of cholera cases in Ndola. Having nearly close to 10% of the total cases recorded. And it is due to this high case count that has led the interest of studying in this area.³

As mentioned, Lusaka reported more than 60% of the cases and having the Copperbelt, particularly

Ndola coming in second of the cases, having recorded over 600 as of 1st April, 2024 with 50% of these cases being found in Masala.⁴ Apart from the statistical impact of the morbidity and mortality cases recorded, another area severely affected by the disease, had been the social-economic progress of the area of Masala. The socioeconomic impact of cholera was mainly characterized by financial concerns shared by residents⁴ reporting loss of family income, as when costs to healthcare services are considered. The general interference with workrelated activities, caused by the disease. This had well led to a lot of businesses closing due to fear and precautionary preventive measures, inspired by the high morbidity rates, especially in the trading areas. Hence hindering economic growth and affecting the lives of some residents whose lives depend on trading. This has also evidently led to affected families to fail to make full recovery from the effects post cholera.

The aim of this research will be to investigate the underlying factors that have influenced the situation in Masala area, in terms of the reoccurring and prevalent cholera outbreaks in that area (especially in the 2023-2024 outbreak). This area is one of the most affected areas in Ndola to the disease each time an outbreak is at the helm of surfacing. By conducting this study, beneficial discoveries and insights will be hopefully made to contribute to the current literature. And hence inspire reforms in policies to better aid on how the disease can be managed and handle.

METHODS

Study Design

We performed a retrospective cross section analysis of 365 respondents, in the epicentre of Masala, Ndola district where most of the cholera cases were identified. This was done in aim of identifying the associated risk factors in this population. Among the households a simple random sampling was administered through questionnaires to collect to on demographics, water and sanitation practices, food hygiene, health-seeking behaviour, and recent

illness history. Qualitative data was collected from 13 informants (e.g. health workers).

The sample size was determined using Fisher's formula, assuming 50% prevalence, 95% confidence level, and a 40% adjustment for non-response. Sampling was conducted by the researcher by first creating a list of households in the area and assigning a number to each. Then a random starting point was generated using a random number table to minimize selection bias.

Data collection tools were pretested in a nearby community of similar social economic settings, this being Chipulukusu area. Key informant interviews followed a semi-structured guide focusing on sanitation challenges, public health response and perceptions.

The study population included all the community of Masala, which is a sub-urban community characterized by dense population clusters. The setting included both residential and commercial areas, with a mix of formal and informal settlements. The population comprises diverse socio-economic groups, including low-income households, informal traders, and migrant workers. Data were entered into excel database then exported into SPSS (version 24.0) for analysis.

Some limitation encountered during the data collection was, Self-reported data were subject to recall and social desirability bias. These were mitigated through triangulation with observational and qualitative data.

Ethical clearance was obtained from Chreso University research ethics committee(CUREC). And Informed consent was obtained. Qualitative responses were anonymized to protect participants' identities.

Subjects

All residents of Masala were eligible in this study. The research had centred on individuals or households living in crowded areas with inadequate sanitation, where cholera cases were highest (such as old Masala area) and also the elderly, as these are

very vulnerable to illness. A list of all households in the residential area was adopted which were then assigned to each household a unique number. The respondents selected from the households were then administered a questionnaire to collect data on demographics, water and sanitation practices, assess knowledge and attitudes, food hygiene, and health seeking behaviours. We had adjusted for non-response at 40%. Semi-structured interviews with key informants; Community leaders, health care workers (HCWs), and local authority to assess the factors influencing cholera transmission in the area.

Statistical Analysis

Using the cholera cases reported by the masala health zone in Ndola district at 50%. A sample size of 384 was calculated (having only surveyed 365) with 95% likelihood that the factors influencing cholera cases were not significant after adjusting for non-response. All continuous variables were assessed for skew and as all (other than urea) had a non-Gaussian distribution. These variables were compared using Wilcoxon rank-sum test and reported by median and inter quartile ranges. For categorical variables, frequencies, proportions and percentages were used to describe the participants and chi-square test was used to assess associations between variables.

Univariate followed by multivariate logistic regression analyses were performed using Pearson's correlation coefficient to determine predictors of cholera cases in the area. Adjusted odds ratios were calculated by multi-variable logistic regression to determine factors independently that are associated with cholera cases among masala residents Ndola district. All reported values are exact and two-tailed, p value of <0.005 was considered significant. Our primary predictors of interest were knowledge levels, common attitudes and practices, environment factors (i.e., Places used as toilets, drinking water sources, water treatment etc.), and food handling hygiene. We counted households that reported a case or mortality during the outbreak. Potential predictor variables included demographics (age and sex),

knowledge factors, common attitudes and practices, influence of health system factors. We used backward selection and excluded predictor variables with highest p values singly until the final model contained only predictor variables with p < 0.05. We obtained approval from Chreso University Ethics Committee (CUREC) and National Health Research Authority (NHRA). All statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) for windows software (Version 24.0).

RESULTS

A total of 365 respondents of median age 34 (20-39) were successfully interviewed between December 2024 to February 2025. The study response rate was 95% with a non-response rate of 5%. There were more female, 228 (62.6%) than male, 137 (37.4%) respondents (**Table 4.1**). The majority, 277 (75.8%) were married and 76.8% had acquired some form of education ranging from primary to tertiary level. Respondents with primary level of education were the majority, 125 (34.2%) followed by those with secondary level of education 113 (30.9%). A greater proportion of participants 253 (69.3%) had no employment at all and majority of those who had some kinds of work were self-employed 256 (70%). Only 6 respondents (1.5%) earned a monthly income of more than 20,000 Zambian kwacha.

Table 4.1: Summary characteristics of study participants of Masala, Ndola district.

Characteristic	Frequency (<i>N</i> = 365)	Percent (%)
Gender		
Males	137	37.4
Females	228	62.6
Age in years		
0–19	14	3.7
20–39	220	60.3
40–59	110	30.2
60–79	21	5.7

Characteristic	Frequency (N = 365)	Percent (%)
Marital status		
Not married	88	24.2
Married	277	75.8
Level of Education		
Never attended school	85	23.2
Primary	125	34.2
Secondary	113	30.9
Tertiary	43	11.7
Employment status		
Employed	112	30.7
Not employed	253	69.3
Type of employment $(N = 7)$	77)	
Formal employment	95	26
Self-employment	256	70
Casual employment	15	4
Monthly income		
<1000	258	70.8
1001-5,000	40	11
5,001- 10,000	33	9
10,001- 20,000	28	7.7
>20,000	5	1.5

According to the study findings, about 136 (37.2%) respondents reported at least a case in the household within the last recent outbreak, 229 (62.8%) had no cases. Four variables were used to score respondents' knowledge on cholera. These included level of education, awareness of cholera risk factors, awareness of prevention approaches of cholera, knowledge of symptoms associated with cholera and awareness of treatment options of cholera. Table 4.2 shows the association between level of education and occurrence of cholera.

Table 4.2: Association between level of education and occurrence of cholera

Level of Education	Acute watery diarrhoea in the last outbreak		
	Yes (N=136)	No (N=229)	P value
	n/%	n/%	
Never attended school	19(13.97%)	74(32.34%)	=0.0010
Primary	40(29.41%)	85(37.11%)	
Secondary	52(38 .24%)	61(26.64%)	
Tertiary	29(21.32%)	18(7.86%)	

Further, results indicate that majority of the respondents, 335 (91.77%) believed that drinking of contaminated water is the main cause of cholera. Most of them 300 (82.29%) opined that eating contaminated food and 238 (65.34%) that not washing hands after visiting toilet were the main causes of cholera. More than half of the respondents 199 (54.61%) mentioned that cholera could be caused by not washing hands before and after handling food. Among the respondents, 172 (47.13%), 147 (40.40%) and 95 (25.94%) agreed that cholera is transmitted through unwashed fruits or vegetables, not washing hands after handling children's faeces and open defecation in bush or roadside respectively.

Regarding the practices relating to cholera prevention, different measures were mentioned including boiling drinking water 310 (85.04%, storing drinking water in a clean container 234 (64.04%), proper use of toilets 230 (63.09%), washing hands after visiting toilets 230 (63.09%). The least mentioned practice was consulting a traditional healer 13 (5.99%). When interviewed on the ways of treating cholera, the largest proportion of the respondents 360 (98.50%) stated that cholera could be treated by visiting the hospital. Among them, 46 (12.72%), 110 (30.17%) and 30 (8.23%)

believed that herbal remedies, homemade oral rehydration and prayer respectively could treat cholera.

However, 3 (0.75%) of the respondents, did not know any method of treating cholera (Table 4.4). With respect to symptoms of cholera, vomiting 333 (91.27%) accounted for the highest proportion. More than three quarter of the respondents 311 (85.29%) mentioned watery diarrhoea. Other mentioned symptoms included fever 201 (55.11%), dehydration 183 (50.07%), abdominal cramps 146 (39.90%) and bloody diarrhoea 62 (16.97%). Overall, only 10(2.74%) of the respondents did not know any symptom of cholera.

Table 4.3 Tabulation of knowledge and attitude levels on occurrence of cholera in Masala community.

		Households recorded a case	Household didn't record a case
	N=365	N=136	N=229
Knowledge and Altitude	n (%)	n (%)	n (%)
Causes of cholera			
Drinking contaminated water	335 (91.77)	129 (94.63)	206(90.08)
Eating contaminated food	300 (82.29)	117 (85.91)	184(80.16)
Unwashed fruits/vegetables	172 (47.13)	90 (66.44)	82 (35.71)
Not washing hands before and after handling food	199 (54.61)	89 (65.10)	111(48.41)
Not washing hands after visiting toilet	` '	94 (69.13)	145(63.10)
Open defecation in bush or roadside	95 (25.94)	44 (32.21)	51 (22.22)
Not washing hands after handling children's faeces	147 (40.40)	61 (44.97)	86 (37.70)

Prevention of cholera			
Boiling drinking water	310(85.04)	120 (88.59)	190(82.94)
Storing drinking water in a clean container	234(64.34)	106 (77.85)	129(56.35)

Proper use of toilets	230(65.59)	99 (72.48)	141(61.51)
Washing hands after visiting toilets	(63.09)	98 (71.81)	133(57.94)
Washing hands before and after handling food	207(51.62)	81 (59.73)	107(46.83)
Drinking treated water	209(52.12)	85 (62.42)	105(46.03)
Drinking river water	27 (6.73)	12 (8.72)	13(5.56)
General personal and household hygiene	202(50.37)	82 (60.40)	102(44.44)
Washing household surfaces and utensils			
with clean water	173(43.14)	71 (52.35)	86 (37.70)
Praying	38 (9.48)	19 (14.09)	15(6.75)
Consulting a traditional healer	24 (5.99)	12 (8.72)	10(4.37)
Proper cooking of food	119(29.68)	59 (43.62)	49 (21.43)

With regard to preventive measures, factors such as storing drinking water in a clean container (p<0.001), proper use of toilets (p=0.03), washing hands after visiting toilets (p=0.01), washing hands before and after handling food (p=0.01), drinking treated water (p<0.001), general personal and household hygiene (p < 0.001), washing household surfaces and utensils with clean water (p < 0.001), praying (p=0.02) and proper cooking of food (p<0.001) were significantly associated with occurrence of cholera. For treatment factors, only homemade oral rehydration (p < 0.001) was found to be significantly associated with occurrences of cholera. Symptoms of cholera such as fever, abdominal cramps and dehydration were found to be significantly associated with occurrence of cholera (p<0.001). However, factors such as drinking of contaminated water, boiling drinking water, visiting the hospital, vomiting among others did not report significant (p>0.05) (Table 4.3). According to a Community Health Volunteer (CHV), part of their duty has been educating people on latrine use to prevent water contamination.

"We have taught every village to have latrines because when it rains our water gets contaminated if we do not use toilets." – a CHV

And another Health officer said, "Every day we make sure that hotels are inspected and that food is sold in clean places to people." – a PHO

To better understand the predictors of occurrencerisk of cholera, this study analysed the independent factors using two models, bi-variate and multivariate logistic models. Table 4.3 presents the results from the bi-variate and multivariate logistic regressions. From the bi-variate analyses, risk factors such as drinking of contaminated water (OR=0.52; 95% CI 0.23, 1.17), eating contaminated food (OR=0.66; 95% CI 0.38, 1.16), not washing hands after visiting toilets (OR=0.76; 95% CI 0.50 1.18) and not washing hands after handling children's faeces (OR=0.74; 95% CI 0.49, 1.12) were not significantly associated with occurrence of cholera case. Unwashed fruits or vegetables, not washing hands before and after handling food and open defecation in bush or roadside were significantly associated with occurrence of cholera though with reduced odds (OR=0.28; 95% CI 0.18, 0.43), (OR=0.50; 95% CI 0.33, 0.76) and (OR=0.60; 95% CI 0.38, 0.95) respectively.

In relation to preventive practices, storing drinking water in a clean container (OR=0.37; 95% CI 0.23, 0.58), proper use of toilets (OR=0.61; 95% CI 0.39, 0.94), washing hands after visiting toilets, (OR=0.54; 95% CI 0.35, 0.84), washing hands before and after handling food, (OR=0.59; 95% CI 0.39, 0.89), drinking treated water, (OR=0.51; 95% CI 0.34, 0.78), general personal and household hygiene (OR=0.52; 95% CI 0.35, 0.79), washing household surfaces and utensils with clean water (OR=0.55; 95% CI 0.37, 0.83), praying (OR=0.44; 95% CI 0.22, 0.87) and proper cooking of food (OR=0.35; 95% CI 0.23, 0.55) were significantly associated with occurrence of cholera though with reduced odds. This study did not find significant association between boiling drinking water (OR=0.62; 95% CI 0.34, 1.14), drinking river water (OR=0.62; 95% CI 0.28, 1.35) and consulting

traditional healer (OR=0.48; 95% CI 0.21, 1.10) at the bivariate level as significant factors. Treatment options or remedies such as prayer (OR=0.69; 95% CI 0.34, 1.40) and/or visiting a hospital (OR=0.84; 95% CI 0.15, 4.66) were not significantly associated with occurrence with cholera. Homemade oral rehydration (OR=0.37; 95% CI 0.24, 0.57) was significantly associated with cholera though with reduced odds. Herbal remedies (OR=1.00; 95% CI 0.54, 1.83) was associated with increased odds-on cholera though with insignificant effect (p>0.05), such that respondents who used herbal remedies were more unlikely to treat cholera than those who did not use home remedies.

Finally, bivariate analysis on symptoms of cholera reported that fever (OR=0.34; 95% CI 0.22, 0.52), abdominal cramps (OR=0.37; 95% CI 0.24, 0.56) and dehydration (OR=0.45; 95% CI 0.30, 1.17) were significantly associated with cholera though with lower odds. Vomiting (OR=0.56; 95% CI 0.25, 1.23), watery diarrhoea (OR=0.64; 95% CI 0.35, 1.18), bloody diarrhoea (OR=0.70; 95% CI 0.42, 1.19) and other symptoms (OR=0.59; 95% CI 0.30, 1.17) were not significantly associated with cholera occurrences (Table 4.4).

Table 4:4 Cholera symptoms and treatment options among the 365 Masala residents

Treating Cholera	N=365 n (%)	Households recorded a case N=136 n (%)	Household didn't record a case N=229 n (%)	P-Value
Visiting a hospital	360(98.50)	134 (98.66)	225 (98.41)	0.85
Herbal remedies	46 (12.72)	17(12.75)	29 (12.70)	0.99
Homemade oral re-hydration	110(30.17)	59(43.62)	51 (22.22)	< 0.001
Prayer	30 (8.23)	14 (10.07)	16 (7.14)	0.3
Don't know	3(0.75)	0	3 (1.19)	0.18
Symptoms of Cholera				
Fever	201(55.11)	97 (71.14)	104 (45.63)	< 0.001
Vomiting	333(91.27)	128 (93.96)	205 (89.68)	0.14
Watery diarrhoea	311(85.29)	120 (88.59)	191 (83.33)	0.15
Abdominal cramps	146(39.90)	75(55.03)	71 (30.95)	< 0.001
Bloody diarrhoea	62 (16.96)	27(20.13)	35 (15.08)	0.19
Dehydration	183(50.07)	86(63.09)	100(43.65)	< 0.001
Other	37 (9.23)	16(12.08)	17(7.54)	0.13
Don't know	10 (2.74)	5(3.36)	5 (2.38)	0.56

We used Chi-squared or Fisher exact when appropriate test was done, 95 % CI and level of significance, =0.005.

Univariate analysis of the environmental and health factors indicates that majority of the respondents used piped water 254 (69.59%) as their main source of drinking water. There were the least of other sources of water used by the respondents as discussed in Table 4.6.

Table 4.5: Knowledge and Attitude levels on occurrence of Cholera in Masala community

Environmental Health variables	All N=365 n (%)	Household with case N=136 n (%)	Household with no case record N=229 n (%)	p-Value
Main sources of drinking water				
Piped water	254 (69.59)	120 (88.23)	134 (58.52)	
Borehole	111(30.41)	54 (39.71)	57 (24.89)	0.01
Others	19(5.24)	1 (0.67)	18 (7.94)	
Distance to water sources				
< 1 km	339(92.77)	131 (96.64)	207 (90.48)	
1-2 km	24(6.48)	5(3.36)	19 (8.33)	0.05
Treat water at household level (Yes)	188(51.37)	99 (73.15)	88 (38.49)	<0.001
Reasons not treating water (N=195)				
It takes a lot of time	24(6.67)	7 (5.00)	16 (7.10)	
It is costly	67(18.46)	31 (22.50)	40(17.42)	
				0.41
Water is okay	217(59.49)	88(65.00)	133(58.06)	
Don't know	56(15.38)	10(7.50)	40(17.42)	
Consistency in treating drinking water (N=206)				
Always	129(35.44)	52(38.53)	73(31.96)	
				0.33
Sometimes	236(64.56)	84 (61.47)	156(68.04)	
Water availability throughout the year (Yes)	205(56.11)	103 (75.84)	102 (44.44)	<0.001
Household own a toilet	188(51.62)	98 (71.81)	91 (39.68)	<0.001
Toilet have hand washing facility (N=188)	185(50.72)	85(62.62)	87(38.00)	<0.001
Reasons not owning a private toilet (N=194)				
Settlement plan by council	193(99.48)	136 (100.00)	227 (99.34)	
				0.6
Others	1 (0.52)	0	2(0.66)	

Places used as toilets (N=194)

115(31.67)	56 (40.94)	60 (26.19)	
240(65.84)	78 (57.05)	163 (71.03)	0.01
3 (0.75)	1 (0.67)	2 (0.79)	
6 (1.75)	2 (1.34)	5 (1.98)	
28 (7.73)	12 (8.05)	17 (7.54)	0.85
')			
71 (19.35)	34 (25.00)	36 (15.79)	
82 (22.58)	45 (33.33)	36 (15.79)	
316 (86.53)	115 (84.56)	201 (87.70)	0.37
306 (83.79)	117 (85.91)	189 (82.54)	0.38
213 (58.35)	93 (68.46)	120 (52.38)	<0.001
152 (41.65)	70 (51.68)	82 (35.71)	< 0.001
83 (22.69)	48 (35.57)	35 (15.08)	< 0.001
	240(65.84) 3 (0.75) 6 (1.75) 28 (7.73) 71 (19.35) 82 (22.58) 316 (86.53) 306 (83.79) 213 (58.35) 152 (41.65)	240(65.84) 78 (57.05) 3 (0.75) 1 (0.67) 6 (1.75) 2 (1.34) 28 (7.73) 12 (8.05) 71 (19.35) 34 (25.00) 82 (22.58) 45 (33.33) 316 (86.53) 115 (84.56) 306 (83.79) 117 (85.91) 213 (58.35) 93 (68.46) 152 (41.65) 70 (51.68)	240(65.84) 78 (57.05) 163 (71.03) 3 (0.75) 1 (0.67) 2 (0.79) 6 (1.75) 2 (1.34) 5 (1.98) 28 (7.73) 12 (8.05) 17 (7.54) 7) 71 (19.35) 34 (25.00) 36 (15.79) 82 (22.58) 45 (33.33) 36 (15.79) 316 (86.53) 115 (84.56) 201 (87.70) 306 (83.79) 117 (85.91) 189 (82.54) 213 (58.35) 93 (68.46) 120 (52.38) 152 (41.65) 70 (51.68) 82 (35.71)

Analysis from chi-square test detected significant association between main source of drinking water and occurrence of cholera (p=0.01). This study reports similar results for treating water at household level (p<0.001), water availability throughout the year (p=0.001), household ways of disposing waste (p=0.03), type of house (p=0.01), washing hands before and after handling food (p<0.001) (Table 4.5). Distance from the water sources and other factors such as sharing a house with animal, washing hands after using the toilet, reasons for not treating water did not detect significant association with occurrence of cholera (p>0.05).

A multiple regression was run to predict occurrence of cholera from level of education, knowledge of cholera risk factors including consumption of unwashed fruits and vegetables, handling food with dirty hands and open defecation; knowledge of cholera prevention measures including proper use of toilet, storing water in clean containers, washing hands with soap after visiting the toilet, washing hands before handling food, drinking treated water, general personal and household hygiene, washing household surfaces and utensils with clean water, proper cooking food, praying; knowledge of homemade oral rehydration solution as a treatment option for cholera; and knowledge of symptoms associated with cholera including fever, abdominal cramps, and dehydration. The summary of results is as shown in Tables 4.5, 4.6, with some thematic analysis of the 13 key informant interviews.

Thematic Analysis of Qualitative Findings

1. Environmental Risk Perceptions

Many respondents expressed concerns about seasonal flooding in the area and its direct impact on water contamination. A community health volunteer

stated, "We have taught every resident in the compound to have well secured latrines and protected wells, because when it rains our water gets contaminated if we do not use toilets." This reflects heightened awareness of how rainfall exacerbates poor sanitation conditions.

2. Institutional Trust and Government Response

Several community members reported dissatisfaction with delayed or insufficient responses from local authorities. One key informant(marketeer) shared, "We always report to the council, but our requests for public toilet cleaning materials and waste bins take too long to be answered." Another resident remarked, "Even when we have piped water, sometimes it's not available for days. We are forced to draw from shallow wells, even if we know it's risky," showing how erratic municipal supply drives unsafe coping mechanisms.

This theme underscores a gap between health needs and service delivery.

3. Knowledge vs. Practice Gaps

While general knowledge about cholera transmission appeared high, actual household practices did not always align. For example, some individuals knew about handwashing but admitted irregular use of soap or skipping after certain tasks such as handling children's faeces.

4. Community Engagement and Ownership

Health officers emphasized the importance of local health education campaigns. A public health officer remarked, "Every day we make sure that hotels are inspected and that food is sold in clean places to people." These efforts reflect growing reliance on community-based interventions in the absence of centralized control.

5. Economic Constraints and Hygiene

Many respondents cited economic challenges as barriers to consistent sanitation practices, as it included the inability to buy disinfectants, soap, or even construct proper toilets, hence discouraged the of proper hygiene. These constraints directly influence hygiene behaviours and vulnerability to outbreaks.

DISCUSSION

The findings of this study identified some factors that played a significant role in increasing the cholera epidemic in Masala community. These factors include people's limited access to clean water, and lack of proper environmental sanitation. These findings correspond to those of another study that qualitatively assessed the resistance toward cholera intervention in Mozambique⁵, wherein insecurity, social factors i.e., poverty, education, and perceived institutional negligence were reported among the factors that aided the spread of cholera epidemics. Another factor that influenced cholera epidemic was flooding due to heavy rainfall, which is prevalent in the areas covered by the case study because of inadequate drainage system. This problem usually contaminates the water sources (i.e. open/unprotected wells) with dirty items, particles, and human waste(from broken sewage pipes) and animal waste, to which many of the participants could attest.6

This finding is related to the findings of another study that assessed the knowledge, attitudes, and practices regarding cholera preparedness and prevention in South Africa. Contaminated water was reported as a major source of contracting cholera disease.⁷

Similarly, lack of proper sewage disposal was identified as another predictor factor because people sell and buy food closer to the bins, food handling was below minimum hygiene standard. Especially in marketplaces which in turn contaminates the food and water around the area. Of which cholera epidemic can occur when people consume the infected foods and water. This finding corresponds to those of a study on Geo-spatial assessment of cholera in a rapidly urbanizing environment, wherein it was stated that waste dump sites affect the environment, which in turn causes the spread of cholera.⁸

The study findings identified some key lessons that are essential for enhancing the prevention and control of cholera. Firstly, contradictions emerged between reported and actual practices in the community. While 85% claimed to boil water, only 51% consistently treated their drinking water. Latrine ownership was limited, and public defecation remained common.

Secondly, there exists substantial evidence on the menace and protective dynamics of the transmission of cholera; taking into recognition of the inhibiting factors such as consumption of contaminated water, unhygienic environment, and inappropriate disposal of waste products, which are all possible routes for the transmission of cholera. Thirdly, the proper and adequate availability of information and awareness of the people regarding the mode and pattern of cholera transmission can help reduce the occurrence of cholera infection and death.⁷

Contrasting with previous cholera outbreaks in Lusaka, the Masala outbreak showed different spatial drivers. According to Ministry of Health In Lusaka, densely populated peri-urban settlements such as Kanyama and Chawama lacked proper drainage and were built on flood-prone land, leading to severe waterlogging and sewage overflow during rainy seasons. While Masala also suffers from poor drainage, its water supply dependency on piped water makes direct sewage intrusion less common than in Lusaka's unplanned settlements. 10,11

In Lusaka, studies have highlighted the role of shallow, hand-dug wells and pit latrines located close to water sources as critical contamination points. In contrast, Masala respondents predominantly used piped or borehole water, yet fewer than half treated their water. This underscores a different behavioural determinant in Masala reliance on untreated 'safe-seeming' piped water, whereas in Lusaka the contamination risk stemmed from the infrastructure itself.^{4,12}

Another contrast lies in public health response. The 2017–2018 Lusaka cholera outbreak saw widespread military enforcement of market

closures, curfews, and the use of chlorinated water tanks. Such interventions were largely absent in Masala during the 2023–2024 outbreak, where community-led initiatives and CHV health education played a larger role. This difference affected public trust and compliance, with Masala respondents showing higher reliance on informal information channels.^{13,14}

Lusaka-based studies reported higher vaccine uptake after intensive government-led oral cholera vaccination campaigns. Meanwhile, in Masala, willingness to vaccinate was mentioned but not heavily supported by infrastructure or consistent rollout, revealing missed opportunities for proactive immunization in high-risk zones. 15,16

In conclusion, this study on the knowledge and practice of prevention measures of cholera transmission such as proper use of toilet (regular latrine cleaning), proper hand hygiene particularly washing hand after visiting the toilet is associated with a low risk of cholera occurrence. The study recommends that the community and community health workers should embrace prevention strategies such as community led total sanitation strategy to strengthen best practices in water, sanitation and hygiene. This is in a door-to-door strategy using community-based volunteers (CBVs).

Practices such as not washing hands after handling children's faeces, consuming unwashed fruits or vegetables, proper cooking of food, hygienic maintenance of the environment as a practice were found to be significant predictors to occurrence of cholera. As such, we recommend the promotion of extensive health education focusing on the role of sanitation and general hygiene with key emphasis on safe waste disposal and proper food handling. These education campaigns are to be run through media platforms(e.g., social media), health centre IEC sessions, etc..

Lastly, willingness to let a child receive cholera vaccine and knowledge of symptoms of cholera were also associated with less occurrence of cholera. We recommend to healthcare providers, community

health education focusing control and prevention of cholera. In addition, community sensitization on the role of oral cholera vaccine would be appropriate. Health sector stakeholders should strive to make the vaccines available to all high-risk regions and areas, just like masala.

Limitations

Logistical challenges, such as limited transportation and accessibility to remote parts of Masala during the outbreak, may have affected how representative the sample was. Additionally, the willingness of respondents to participate during a health crisis could introduce selection bias. Self-reported data on hygiene practices and health-seeking behaviours may introduce recall bias or social desirability bias, where respondents over report ideal practices (e.g., handwashing) or underreport stigmatized behaviours.

CONCLUSION

This study spotlights the determinants influencing the high prevalence of cholera in Masala, Ndola. Key protective factors included proper toilet use and consistent hand washing after toilet use, emphasizing the role of sanitation and hygiene in mitigating transmission. Conversely, significant risk factors such as inadequate hand hygiene after handling children's faeces, consumption of unwashed fruits/vegetables, and improper food handling practices really highlighted vulnerabilities in daily hygiene behaviours. Socioeconomic factors, including low income and limited education, compounded these risks, as households with lower educational attainment reported higher cholera incidence.

Qualitative data reinforced these findings. One resident remarked, "Even when we have piped water, sometimes it's not available for days. We are forced to draw from shallow wells, even if we know it's risky," showing how erratic municipal supply drives unsafe coping mechanisms. Another respondent lamented, "We share one latrine with four other households. It gets full quickly, and no

one wants to take responsibility," capturing the depth of the sanitation crisis in high-density homes.

The findings emphasize the urgent need to address gaps in sanitation infrastructure and community health literacy. Reliance on preventive measures like boiling water and proper food storage was inconsistent, while some respondents cited prayer or traditional healers as treatment options, reflecting persistent knowledge gaps. These practices, coupled with overcrowded settlements and inadequate access to clean water, perpetuate cholera transmission.

To curb further outbreaks, targeted interventions must prioritize community-led health education to reinforce hygiene practices. Conduct door-to-door campaigns emphasizing hand washing and safe food handling. Prioritize latrine construction and water drainage improvements in high-risk areas of Masala, Distribution of chlorine to community members by health facility workers and CBVs. Increase community awareness and accessibility to oral cholera vaccines. Strengthening healthcare systems for early case detection and treatment, alongside strong policy reforms to improve urban planning and livelihood opportunities, will surely reduce vulnerabilities. Collaborative efforts involving local authorities, health workers, and community leaders are essential to sustain behavioural change and build a resilient front against future outbreaks. Addressing these drivers will not only mitigate cholera but also enhance overall public health outcomes in Masala.

What is already known on this topic

- Cholera transmission is strongly linked to contaminated water, poor sanitation, and inadequate hygiene practices, particularly in overcrowded urban and peri-urban settings.
- Zambia has experienced recurrent cholera outbreaks since 1977, with Lusaka historically being the epicentre, driven by factors like informal settlements and limited access to clean water.

 Preventive measures such as improved sanitation, hand washing, and oral rehydration therapy (ORT) are effective in reducing cholera morbidity and mortality.

What this study adds

- The study identified localized risk factors in Masala, Ndola (e.g., unwashed fruits/vegetables, improper food handling, and lack of hand washing after handling children's faeces) that uniquely drive cholera transmission in this understudied outbreak hotspot.
- It Highlighted the critical role of community-specific interventions, including targeted hygiene education, toilet ownership promotion, and cholera vaccination awareness, to address gaps in prevention practices.
- And provided qualitative insights from front-line health workers and community volunteers on structural challenges (e.g., water contamination during rains) and actionable strategies to mitigate future outbreaks in similar settings.

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